THE

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THE

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1900

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## THE COMMERCIAL POSSIBILITIES OF WIRELESS TELEGRAPHY.

In spite of the usefulness of wireless telegraphy, some of the shareholders of the Wireless Telegraph Company were naturally somewhat disappointed at the statement laid before them by Major Flood Page last Friday. Few of them probably expected anything in the shape of a monetary return, but the record placed before them was hardly encouraging. Wireless telegraphy up to a given distance is perfectly feasible and practical; but without wishing in the slightest degree to discourage the workers in this field, we doubt whether it is likely to be used to a sufficient extent in this country to permit the payment of dividends for a long time to come. It is certainly a most fascinating and interesting branch of electrical work, but after all, the principal thing that concerns investors and business men is its earning capacity. In this country its operations, as far as one can see, must be confined to signalling between ship and shore, and neither Lloyds nor shipping owners appear to be anxious to take up the system. Yet it fully proved its value in the storms of last year by transmitting messages between the East Goodwin lightship and the South Foreland lighthouse. But assuming every lightship and lighthouse round our coasts were supplied with the system, how much would that represent in dividends? We fear very little. Of course, if such an organisation as Lloyds, or even our own Admiralty, were to take up wireless telegraphy, the outlook, from the shareholders' point of view, would be distinctly better, but in the original negotiations with Lloyds, we believe, certain difficulties arose which apparently have not been overcome. One serious obstacle against a rapid development of wireless telegraphy seems to be that a skilled supervisor is required; for instance, if the Wireless Telegraph Company were to make apparatus to sell to all comers, the probability is they would do a large business, but, as far as we can learn, they do not care for the apparatus to go out of their hands, or, put in another way, they do not care to supply apparatus unless they supply a supervisor with it. Unless some very great modification of such methods is adopted, we doubt whether the business will ever be of much magnitude. There are many conditions to which wireless telegraphy is admirably adapted; for giving a rapid interchange of intelligence between groups of islands where a submarine cable would be impracticable it would be of great use, and in time of war it would be of the greatest service in preserving communications between outlying bodies of men and a main army. In the case of the beleagured towns of Kimberley, Ladysmith and Mafeking, the ability to flash news at all times and in all circumstances to an advancing army would have been of incalculable value, but the ignorance or crassness of our War Office prevented the despatch of the material necessary to form complete wireless telegraph sets. Had such been sent out at a time

when active hostilities had not commenced, they might have had some effect upon the course of events. We do not pretend to have sufficient knowledge to enable us to criticise War Office methods on matters of guns and dispositions of men, but if these are dealt with in a manner similar to that in which it treated one of the most promising inventions of modern times, then the safety of the country demands some sweeping changes in Pall Mall.

The later experiments in wireless telegraphy tend to show that one of its most useful spheres of operation is a maritime one. We do not know what the official pronouncement of the Admiralty is, but presumably the officials of that institution attach some value to the system, for negotiations have been going on between the Treasury and the Wireless Telegraph Company for some time, though the chairman spoke somewhat dubiously of the terms suggested. Apparently the views of other naval authorities are distinctly in favour of the system, but what is more to the purpose, several lighthouses and lightships on the German coast are being fitted up by the Wireless Telegraph Company.

In view, however, of the possible maritime uses, one naturally feels a little staggered at the proposals of the Board, which are in effect that the present company should sell their maritime rights to another concern for paid-up shares in the new organisation and the right to subscribe for further shares. Apparently this was not altogether to the liking of the shareholders, for a vigorous protest was made against the proposal. Considering the patience which has been exercised by the shareholders of the Wireless Telegraph Company, it must have been a little trying to be calmly told that this most valuable right was to be bartered away for paper. Nothing short of a considerable sum in cash should have been accepted, and it is difficult to understand directors having the courage to bring forward such proposals.

---

The London County Council and Electric Lighting Loans.

In our issue for December 29th, we drew attention to the action of the London County Council in refusing sanction for electric light loans to the Islington Vestry, on the grounds that the engineer's estimates were excessive. We raised the point as to whether the County Council or its officials had the necessary technical knowledge to criticise the figures of the Islington Vestry's engineer, but we are now able to see for ourselves how the County Council officials endeavour to upset carefully made estimates. In our last issue there appeared a report by Mr. Gay to the Islington Vestry, which sets forth the grounds on which he differs from the County Council officers on the subject of the estimates. It appears that for the extensions for which the loan is asked 12½ miles of cable is required, and this will be utilised in certain specified streets. Immediately the official mind, with a penetration that would do credit to the late lamented Sherlock Holmes, measures up the streets on the plans and finds that the frontages only measure 9 miles; therefore, say the County Council, the estimate of Mr. Gay's is 39 per cent. in excess of that required. But with a calm disregard for details, the officials of the County Council have overlooked the fact that in some conduits two cables will be laid. Moreover, to get to the districts specified and carefully measured up necessitates new mains from the works; then no one lays electric lighting mains without making provision for connections, slack in boxes, joints, &c., and these are items which go to make up the 12½ miles. In another instance 20½ miles of cable is asked for, but the official of Spring Gardens with his magic foot rule brushes that aside, and states that the actual frontage is only 13 miles. Here, again, the official mind has gone astray, and left out of consideration mains from the works, various return loops, connections to lamps, slack, &c. It is on such trumpery and mistaken grounds that the County Council refuses to grant the Islington Vestry the full amount for which it asks. Yet not more than a week ago our contemporary, the *Globe*, pointed out the extraordinary discrepancy between the estimates of the Works Department of the County Council for asylum buildings and the actual expenditure—a difference of many thousands of pounds. To our mind the treatment accorded to the Islington Vestry approaches the scandalous, and in the interests of municipal electric lighting the attention of Parliament ought to be called to it. Probably some such action would be taken were it not for the fact that the Vestry may be able to pursue a course which will be outside the jurisdiction of the London County Council. The remarkable attitude adopted by the County Council in regard to Islington is shown by the fact that it did not ask for specific information within a short time after the application had been made, when no doubt many points could have been cleared up, but waited some months before asking for details. In the meantime, the Vestry is kept waiting, and what is of very great importance, the price of materials is steadily going up, with the result that the estimates may be exceeded. If there is any difference between the estimate and the actual outlay it is a pity there are no means by which the County Council could be surcharged with it.

---

Liquid Fuel Burning.

Mr. Holden, of the Great Eastern Railway, continues to extend the use of liquid fuel, and has applied it during the past summer to his new single-driver bogie express engines. These engines have 1,298 square feet of heating surface and 21 of grate area, and the cylinders are 18″ × 26″. Two sprayers are used as heretofore, but of somewhat modified pattern. There is a central annular steam jet which draws air down the middle and ejects the liquid fuel from the front nozzle. The air supply is heated by an apparatus in the smoke box fed from the atmosphere in front of the engine. The fuel tank holds 750 gallons or probably 7,000 lbs., and is placed in the water space, and the fuel is also heated by passing through a cylindrical warmer heated by the exhaust from the air brake pump. The temperature of the air is about 400°, and the fuel is heated and diffused by steam of 300° to 350°, so that the final temperature of the fire must be considerably higher than it would be with cold air. Two large hydraulic dredges recently supplied to the Russian Government have been fitted to burn liquid fuel, being intended for use on the Volga within easy reach of astatki, and the emergency and construction locomotive on the Central London Railway is also fired with liquid so as to avoid the smoke in the deeply buried tunnels where it is considered inadmissible. Evidently Central London directors are not of the same views as Metropolitan directors, who never even attempted to minimise the evils of fire locomotives by the use of liquid fuel. We understand that the crude petroleum from the Borneo oil fields has been lately tried, and has given satisfactory results. It is a matter of surprise that hard-pushed electric light stations in London and other large towns have not adopted liquid fuel for getting over the severe peaks of load. It is easy to put on and take off the fuel supply, so that an almost instantaneous fog could be met by the equally rapid production of a furnace full of white flame of full steam producing power. Borneo oil appears likely to be supplied in very great quantity, and to become in many cases a serious rival to coal. A fire of coal cannot at once be urged into activity to meet a sudden call for steam, and it is the power of being so treated that makes oil so very valuable a fuel for meeting sudden loads. A very little apparatus in the shape of oil burners would prevent a number of police court appearances on the part of electrical station engineers, for it must be understood that liquid fuel can be burned absolutely perfectly and without smoke. We had the pleasure of a run on one of Mr. Holden's engines some years ago, since which time the system has been considerably improved and extended, but we were satisfied then that no smoke need be made, and it was easy to adjust the air to prevent it.

## SOME NOTES ON BALANCING AND BOOSTING SETS.

By R. WIGHTMAN.

Ever since the three-wire system became generally adopted for continuous-current supply from central stations, the balancing set has been a familiar feature of the station plant. Its function, as its name implies, is to balance any want of equality between the loads on the two sides of the system, that is, it deals with the current flowing through the middle wire. In recent practice, however, it has had an additional duty imposed upon it, being also employed to drive one or two boosting dynamos, the function of these latter being to provide the additional E.M.F. that is required for charging the accumulators over and above that given by the main dynamos which are connected to the bus bars.

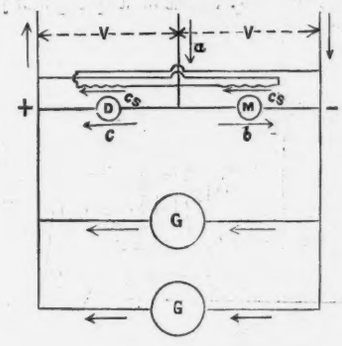
Hitherto it has been the custom to arrange for one or more of the main generators to be uncoupled from the bus bars, and to have their E.M.F. raised to that required to charge the accumulators; but this method has certain disadvantages, and the plan indicated above is the one now usually adopted.

It is not proposed in this article to give an account of the three-wire system itself, nor of its *raison d'être*. For this we would refer our readers to any of the excellent text-books on general electrical engineering. Our purpose is to deal with the balancer, its function and design, and to notice how these are affected by the addition of the boosters to the balancing set.

As a rule, the balancer consists of two identical dynamos having their armatures coupled together. Sometimes there are two separate windings on one armature core, with two commutators, one at either end of the armature. In this case there is only one field magnet; but, as special devices have to be adopted to obtain independent regulation of the E.M.F. of the two windings, this plan is not usually adopted, and in what follows we shall assume that there are two separate machines coupled together.

Each armature of the balancing set is designed to give the E.M.F. required to supply current to one side of the system when running at some pre-arranged speed.

Fig. 1.



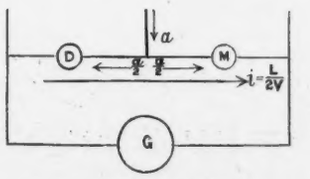




Fig. 2.

Fig. 1 represents, diagrammatically, a scheme of supply on the three-wire system, G G being the main generators, and D M the two armatures of the balancer. Let V = the voltages across each side of the system, which, for the sake of simplicity, we shall assume to be equal. Let $a$ = the maximum current to be dealt with in the middle wire. If $a$ flows in the direction of the arrow in the figure, and the polarities are as indicated, M will be the motor side of the balancer, and D the dynamo side; for that portion of $a$ which passes through M, goes from $a+$ to $a-$ brush through the armature, while the portion that passes through D does so from $a-$ to $a+$ brush. Let $b$ and $c$ be the currents through M and D respectively. If $\eta' =$ the efficiency of conversion, *i.e.*, the ratio of the power put into the motor armature, to that given out at the terminals of the dynamo armature, we have

$$c = b\,\eta', \text{ and } a = b + c = b\,(1+\eta'), \therefore b = \frac{a}{1+\eta'}.$$

It will be noticed that in reckoning $\eta'$, we have left out of account the watts required to excite the two balancing machines. This is legitimate, as the fields are practically connected in series across the outers, and carry equal currents in the same direction, *i.e.*, from their + to their − terminals in each case.

Let F = the total watts lost in friction in the whole set;

H and E = the hysteresis and eddy current losses in the two balancing armatures;

$R_a$ = the resistance of each balancing armature.

Total losses in armatures $= R_a(c^2 + b^2) + F + H + E = L$.

Output of dynamo side $= V\,c$.

Input of motor side $= V\,c + L = V\,b$.

$$b = c + \frac{L}{V},$$

or since $c = a - b$, we have $2\,b = a + \frac{L}{V}$,

$$\text{or } b = \frac{a}{2} + \frac{L}{2\,V} \quad \ldots\ldots\ldots (1)$$

This gives us an expression for $b$, the current in the motor armature, in terms of the middle wire current, the watts wasted in heat, and the voltage across the outers. It will be observed that $b^2 R_a$ is one of the terms that make up L. The best way to deal with this is to assume some value for $b$, and if necessary, correct it in this term, if the value assumed does not agree with that finally calculated.

It will be seen at once that while

$$b = \frac{a}{2} + \frac{L}{2\,V}, \quad c = \frac{a}{2} - \frac{L}{2\,V}.$$

We may thus consider that the current $a$, in the middle wire, is divided into two equal parts, one passing through M as a motor current, and the other through D as a dynamo current, and that superimposed on these is a motor current $i = \frac{L}{2\,V}$ passing through the two armatures in series (see fig. 2). It is this current $i$, obtained directly from the main generators, which really drives the set. To obtain a complete statement of the case, we must add to $i$ the current $C_s$ required to excite each half of the balancer. The total losses are therefore $2\,V\,(i + C_s)$, and this represents the cost of running the balancer.

Although the actual losses are the important thing for the central station engineer to know, the designer is often asked to give the efficiency of the set. With the maximum current, $a$, in the middle wire, this evidently is equal to

$$\frac{V\,c}{V\,c + L + 2\,V\,c_s} = \frac{\frac{V\,a}{2} - \frac{L}{2}}{\frac{V\,a}{2} + \frac{L}{2} + 2\,V\,c_s}$$

$$= \frac{V\,a - L}{V\,a + L + 4\,V\,c_s} \quad \ldots\ldots\ldots (2)$$

It will be noticed that in fig. 1 the field windings are shown cross connected, that is, the field winding of the machine whose armature is connected to one side of the system, is itself connected to the other side. This enables the balancer to be, to a certain extent, self-regulating. Suppose, as is indicated in the figure, that the positive side of the system is the more heavily loaded. This will tend to make the P.D. less on the positive side than on the negative side. This, again, will cause a reduction in the motor field, so that the balancer will run faster, and the E.M.F. of the dynamo armature be increased, thus tending to bring about an equality of the P.D. on the two sides of the system.

Additional hand regulation is usually obtained by placing a single adjustable resistance between the two field windings, and connecting the movable switch of this to the middle wire,

as shown in fig. 3. By this device, as resistance is cut out of one field, it is inserted into the other field, so that it is possible to divide the total voltage across the outers, between the two sides in any ratio that may be desired, within certain

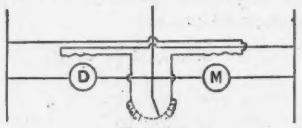



Fig. 3.

limits. If one side of the system is more heavily loaded than the other, the voltage of this side, at the station, may have to be raised above that of the other side, in order to get equality in the distributing mains. This will be effected by moving the regulating switch, so as to introduce more resistance into the motor field, and so diminish its strength, causing the set to run faster, while at the same time the dynamo field is increased, which, in conjunction with the increased speed, raises the voltage on this side of the system. It should be noted that the armature which is connected across the more heavily loaded side always acts as a generator, whether the voltage of this side be higher or lower than that of the other side.

Hitherto we have been considering a simple balancer consisting of two machines coupled together, and have found a value for $b$, the maximum current which each armature must be designed to carry. We will now consider the case in which one or two boosters are coupled to the balancer. We have already seen, when balancing only, that so far as the current $i$, which drives the set, is concerned, the two balancer armatures may be regarded as one motor armature connected across the outer wires. Similarly, in the present case, we may consider that, in addition to $i$, we now require an extra motor current, $d$, to drive the boosters.

Let B = the maximum output in watts of the booster, or, if there are two, of the two boosters together. Let K = the copper, hysteresis, eddy current, and friction losses in the booster armatures.

Let $m$ and $n$ be the currents through M and D respectively. As before, $m + n = a$. The losses in the balancer armatures now $= R_a (m^2 + n^2) + H + E + F = L'$.

Now, $m = \frac{a}{2} + i + d$, and $n = \frac{a}{2} - (i + d)$, while $b = \frac{a}{2} + i$, and $c = \frac{a}{2} - i$.

It is evident that the total copper losses in the two balancing armatures, with a fixed value for $a$, are a minimum when the currents through D and M are equal to one another, *i.e.*, are each equal to $\frac{a}{2}$, and that the more they depart from equality, the greater become the copper losses. Hence, as the other losses are practically constant, $L' > L$.

We now have

$$V m = V n + B + K + (L' - L) + L,$$

$$\text{or } m = \frac{a}{2} + \frac{L}{2V} + \frac{B + K + (L' - L)}{2V}$$

$$= \frac{a}{2} + i + d.$$

Hence $d$, the additional motor current required to drive the boosters $= \frac{B + K + (L' - L)}{2V}$.

$m$ is the maximum current which either balancing armature will be called upon to carry, and they must each be designed to carry this.

It is interesting to observe that although the current in the middle wire may remain constant, the current through the dynamo side of the balancer is reduced as more and more load is put on the boosters, until $n$ becomes 0. When this happens $m$ becomes $= a$, *i.e.*, $i + d = \frac{a}{2}$.

As a rule, the output required from the boosters will not be such as to cause $m$ to exceed this value; but if it is, both sides of the balancer will become motors, one side, however, doing much more work than the other. The above investigation will still hold good, if we bear in mind that $n$ will now be negative, if we reckon its direction as a dynamo current, positive. If $W_s$ = the watts required to excite the boosters (one or two as the case may be), the total losses of the set when fully loaded $= L' + K + 2 V C_s + W_s$.

The efficiency under these conditions

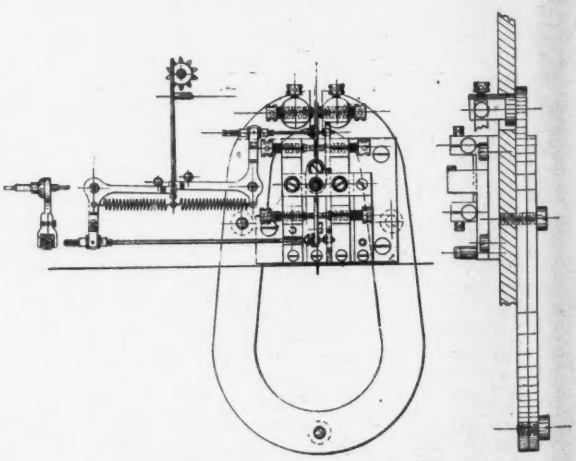
$$= \frac{V n + B}{V n + B + L' + K + 2 V C_s + W_s} =$$

$$\frac{V a + B - (K + L')}{V a + B + K + L' + 4 V C_s + 2 W_s}.$$

A few words might here be added with respect to the boosters. It will be evident that these must be able to give out the full charging current over a very wide range of E.M.F., since on commencing a charge, a very small extra voltage is required, which has to be increased to a considerable amount as the charging progresses. This is the only difficulty that has to be overcome in the design of the boosters themselves—the necessity for getting them to work without sparking at the brushes when giving their full current with a very weak field. Attention must be given to see that the boosters are so designed that they give their full E.M.F. when running at the slowest speed of the balancer and excited by the lowest voltage that will occur on either side of the system. At the same time, the resistances in the fields of the boosters must be such as to reduce their voltages to the minimum amount required when the set is running at its highest speed and the fields excited by the maximum voltage of either side.

## IMPROVEMENTS IN WHEATSTONE AUTOMATIC TELEGRAPH APPARATUS.

Telegraphic apparatus for high-speed working is necessarily subject to exceptional wear and tear, and it is principally in attention to points of detail in construction that such wear and tear can be diminished. In the ordinary form of Wheatstone transmitter the contact lever is held over to the contact points by means of a spring and jockey roller



Magnetic Bias for Automatic Transmitters.

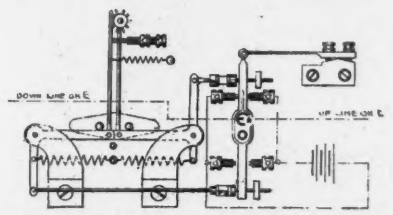
operating upon the end of the lever. This arrangement not only necessitates a considerable movement of the lever to get upon either side of the centre of the roller, but a heavy downward pressure is caused which has to be overcome by the contact lever in passing from side to side. There is considerable friction between the jockey roller and the end of the lever, and a lubricant has to be used to reduce it. This sometimes finds its way down between the electrical contact points, thereby rendering their action uncertain.

Again, in the ordinary form of instrument, the pivoting of the crank levers and horizontal levers is formed by flatten-

ing the ends of the wire forming the lever to the thickness of paper, and drilling a hole, into which a pin in the crank lever passes. The friction between the lever and the pin soon causes the hole in the thin metal to "draw" and throw the instrument out of adjustment. The adjustments, moreover, of the horizontal levers are made by nuts on each side of the contact lever, and are consequently very difficult of access and adjustment.

Mr. J. Willmot, Superintendent of the Postal Telegraph Instrument Factory, has had these defects in view, and with the object of overcoming them, has introduced the following improvements:—

1. Substitution of a permanent magnet for the spring and jockey roller now used for holding over the vibrating contact lever. The adaptation of the magnetic arrangement entirely removes the downward pressure of the jockey spring, and greatly increases the holding-over force operating upon the contact lever, thereby causing more perfect impact and, consequently, contact between the contact points. The



Automatic Transmitter, showing Jockey Wheel and Spring.

force necessary to drive the instrument when fitted with the magnetic arrangement is considerably less than with the jockey roller, due to the fact that the downward pressure on the pivots is entirely removed; also, as the pull is directly from side to side, and obeys the laws of magnetism, no sooner does the lever commence to move from the pole of the permanent magnet to which it is nearest, than the attractive force of that pole decreases as the square of the distance, and at the same time the pulling power of the pole to which it is approaching increases in a like proportion, a condition most favourable to the object in view.

With the spring and jockey roller arrangement it is necessary to continually lubricate the roller, the oil thus used finding its way between the electrical contact points. With the magnetic arrangement this defect is, obviously, entirely removed.

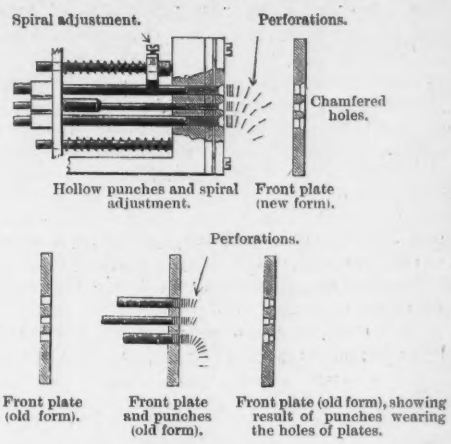
2. Substitution of properly-pivoted crossheads for the holes and pin joints of the horizontal levers, and arranging the screw adjustments in such a manner to permit of easy and convenient access. This arrangement considerably reduces the wear and tear of the instrument, and consequently prolongs its life.

The arrangement of the improved apparatus is shown by fig. 1.

Another important improvement which Mr. Willmot has introduced, and which has proved a great success, relates to the Wheatstone "perforators."

The punches of these perforators require frequent sharpening in consequence of the edges of the punches wearing away by the action of the oiled paper perforated. This is principally due to the fact that at each blow of the punch a film of dried oil is deposited by the paper upon the surface of the punch, which soon builds up into convex form, the consequence being that the paper is bent over the punch before being perforated, and quickly wears away the cutting edge of the punch. The punched-out portions of the paper being bent by this process, are sluggish in leaving the perforated plates.

To remedy these defects Mr. Willmot has devised a punch having a hollow recess at its end, as will be seen in fig. 2; it having no centre on which a deposit of oil can take place, the surface of the punch remains flat and makes a clean perforation. It has a further advantage, *i.e.*, that in coming into contact with the paper to be perforated a small amount of air is compressed in the recesses of the punches, which air, after the perforation has been made, tends to blow away the punched-out portions of the paper, and also to prevent any oil or foreign matter accumulating in the recesses of the punches. When they require sharpening, the hollow or recessed punches are more easily ground and a flatter surface obtained than is possible with solid punches, because, firstly, having no centre there is less metal to grind away; and,


Spiral adjustment.
Perforations.
Chamfered holes.
Hollow punches and spiral adjustment.
Front plate (new form).
Perforations.
Front plate (old form).
Front plate and punches (old form).
Front plate (old form), showing result of punches wearing the holes of plates.

Willmot Punches.

secondly, for the same reason, they lie more flat upon the cutting surface of the oil-stone used for the purpose of sharpening.

## THE CONSTRUCTION OF OVERHEAD EQUIPMENTS.

### II.

(*Continued from page* 304.)

When still some distance from the vertical the pole commences to slide on the edge of the hole and against the back plate, and finishes without the further assistance of the pusher poles. All the poles that are to be set that same day may thus be erected one after another. They are perfectly safe from falling, and may remain as they are till next day if the holes are guarded. Much of the celerity with which the poles can now be finished depends upon the facilities for concrete mixing. The materials for this should preferably be distributed along the route at every 120 to 200 yards, from which point the mixed stuff can be carted to each pole. Some engineers prefer to mix the concrete alongside of each pole, and do not cart any wet stuff. All depends on local conditions. The concrete should be sufficiently damp not to be quite loose when carted. It may be so damp as to just flush up wet on the surface from the vibration of carting, but it should not be so sloppy as to quake, or it will require some time to set firm enough to hold steady a raked pole. Before a pole is concreted it has to be aligned. This is best done by setting it truly vertical and gauging its position by means of a wooden rod. With good kerbing the instrument shown in fig. 10 may be used. If not the right distance

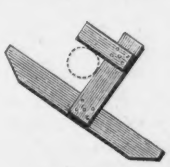


Fig. 10.

Fig. 11.

from the kerb, the pole is to be so placed by gently bumping it against the side of the hole away from which the pole is required to be moved. This bumping moves the butt of the pole on the base flag lining the bottom of the hole, and cannot be effected at all when the hole is soft, hence the need of these hard base pieces. When thus made true to line, concrete is to be filled in, and rammed as it is thrown in, up to a depth of about 2 feet. It is now that the pole is to be correctly set; 2 feet of the right concrete will hold a pole steady. It is to be set exactly plumb as regards the view across the street, and with its top end raked back 5½ inches

to 6 inches when looked at along the direction of the street. If a pole is 30 feet in length, this rake, which does not apply at all to double-bracket centre poles on a straight track, will amount to 1 in 60, or thereabouts, or approximately $\frac{1}{8}$ths inch in a 2 feet rod, or $\frac{3}{16}$ths in a foot rule. The most useful instrument for pole-setting is a spirit level fixed in a wide straight-edge (fig. 11), such as often employed by bricklayers to plumb walls. A rule of 12 inches will be found sufficient. It is used as a plumb on the sides of the poles along the line of route, but for giving the poles the backward rake little wedges or blocks should be arranged to stand clear at the ends of the rule. This block may be a cross slide with a thumbscrew to fix it. When applied to the street side of the pole the little block is kept out at the top; when from the field side, the rule is reversed, and the little block is kept out at the lower end.

The above amount of rake is simply that usual on span-wire poles upon straight lines, and it is usually sufficient for all span poles, though on curves the pull is naturally intensified upon one side of the road, *i.e.*, upon the poles on the

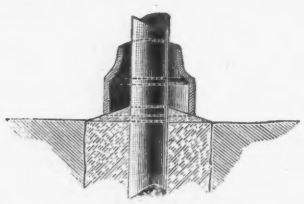


Fig. 12.

convex side of a curve, and those poles on the concave side may perhaps be raked something less than the opposite poles. Side bracket poles require a rake in accordance with the length of the bracket arm attached to them while centre poles require a very slight rake to meet the pull of the trolley wire on curves. When the rake upon a pole would thus exceed 6 inches, it is desirable that the pole should be chosen a size stronger than the others, so as not to require so much rake.

The set of the pole is given to it by pressure in the direction it is required to move. This compresses the concrete against which the pole is pushed, and where left slack on the other side, the concrete is simultaneously rammed (*see* figs. 13, 14 for rammers). The true position

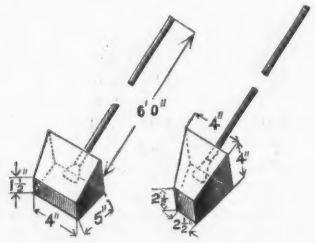



Fig. 13.




Fig. 14.

being thus readily secured and fixed, the remainder of the concrete is rammed in, the two men ramming working on opposite sides. When the hole is two-thirds full, a final plumbing should be made to check the stability of the pole, when its position can still be slightly corrected if necessary. This is rarely found to be the case with not too moist a concrete. In finishing off the concrete the upper 3 inches should be put in of finer and wetter stuff, and sloped up towards the pole (fig. 12). The base may then be let down, and the surface cleaned up. It still remains to set the base castings: this operation is better left until later, when the concrete has set. Properly speaking, the castings should be raised, the pole cleaned and hot tarred down to the concrete and upon it. The base may then be lowered and fixed truly parallel with the pole. It is usual to make the joint at the top of the casting by pouring in melted lead upon a grummet ring of yarn and well caulking it. This is an expensive method which might be changed for a filling of neat or nearly neat Portland cement, which will make a tight joint if the pole is cleaned of paint so that the cement can adhere. In order that the concrete round the poles may be made thoroughly to fill the excavation, the rammers are made conical so as to exert a detrusive action. Two sizes of rammers are sufficient, one a flat the other square and more massive. They are cast upon 1 inch round iron handles. When setting a pole to proper rake it may be steadied in the correct position by placing round it four of the longer pusher poles, fig. 9, with their butt ends on the floor and their forks against the pole. The four props act as struts, and prevent the pole from moving while being rammed up. In order that the push-up poles may not slip upon the smooth surface of the pole they may be wrapped with tarred yarn.

Some of the tower wagons used on overhead equipment work are provided with a derrick for pole erection. As poles are about 30 feet long, and are considerably heavier at the butt end than at the top, they will usually balance at about 13 feet from the butt. The derrick must be able to raise the poles, when slung in the balance position, so that the butt can be lowered into the hole. The derrick system is obligatory when the staff of men is small, but it entails the expense of an extra horse and driver, and is, perhaps, at its best when holes can be excavated ahead, and the poles erected and left without setting until the setting gang comes round. When the work of electrical tramway construction has become more an everyday occurrence, and the officials of local and other authorities cease to look upon tramway constructors as enemies to be hindered and obstructed at every turn, it will become possible to construct long lengths without the certainty of being stopped every 100 yards, and the rapidity of work will be much greater.

Probably the best results will then be obtained by dividing the work of pole erecting between three or four gangs, using the derrick in place of the pusher-up poles. But it would appear from American experience that the derrick cannot be so much superior to the hand method, for the latter seems to hold its ground, and is, when properly carried out, a very rapid method of getting through the work.

(*To be continued.*)

## SOME MECHANICAL DETAILS OF DYNAMO DESIGN.

By E KILBURN SCOTT.

There are a number of minor details in the manufacture of dynamos which, taken individually, may appear insignificant, but, bulked together, make all the difference between

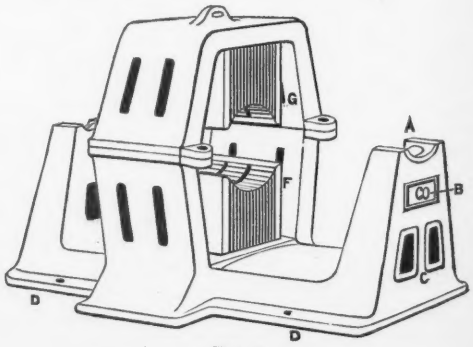



Fig. 1.

a saleable machine and one that is not. The word "finish" is used in this connection not merely to express that a particular machine is highly polished and painted in good taste, but that the smallest detail and curve has the appearance of having had thought and attention given to it.

*Bedplate.*—The bedplate of a dynamo is a simple piece of work, yet how often does it consist of a flat rectangular box casting, with the pedestals bolted on in much the same way

that a cheap experimental machine would be put together! Such built up arrangements were excusable in the early days, but there is no room for crude work now.

The continued use of plain rectangular wrought-iron or steel slabs for magnet construction in bipolar machines prevents any radical change in the appearance, and it is only by adopting some such design as sketched in fig. 1 that makers can break away from the two-pole standard pattern. It is a favourite type on the Continent, and is superior to the Manchester field, because the field coils come close up to the face of the poles, that is to say, in the most effective position.

Compared with the ordinary two-pole machine, there is much more scope for artistic design in the multipolar machine. Take, for example, fig. 2, a design of bed and

Fig. 2.

framework which has been popularised by the American firms, and the curves in which are most pleasing to the eye.

Briefly put, the points to be noticed in bedplate design are :—

(*a*) There should be as few machined joints as possible between the armature spindle and the floor line.

(*b*) Horizontal surfaces should be cambered, as shown at

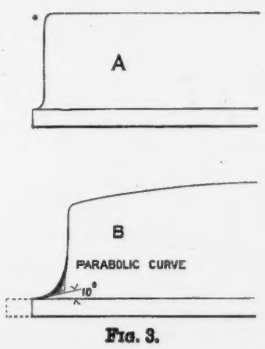



Fig. 3.

B, in fig. 3, and the corners should be true curves, not simply sections of a circle, as at A.

(*c*) Flat vertical surfaces should be relieved by beaded hand holes, these also forming convenient places to hook on the sling chains.

(*d*) A useful detail indicated at D, in fig. 1, especially for small machines, is to allow for a flange running along each side of the casting, so that in case the usual position of foundation bolt is not suitable, it is an easy matter to drill another hole further along the flange. The holding down bolts are also several inches shorter than if carried right through the deep part of the bed casting.

Mechanical joints between the armature spindle and the ground line, besides adding to the cost, are liable to give trouble through misalignment, although this latter is sometimes prevented by the self-centreing type of bearing, shown in fig. 4. As a matter of fact, many specifications now ask

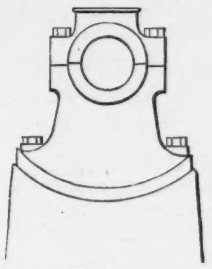


Fig. 4.

for the armatures to be removable by a direct vertical lift, so that the necessity for a separate bearing has practically disappeared.

*Field Magnets.*—One of the very first Kapp machines made by Messrs. Johnson & Phillips was arranged with the magnets cut across at centre line so as to enable the armature to be removed by a straight vertical lift. Fig. 5 shows the

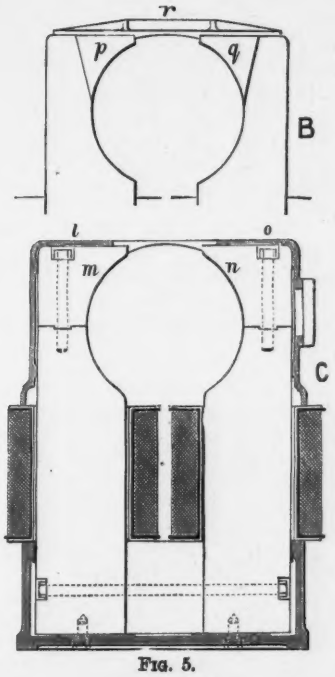



Fig. 5.

method adopted several years ago at the Bushbury Works, Wolverhampton, but owing to the expense of machining the V-shaped pieces, *p* and *q*, and the gun-metal casting, *r*, this was dropped for the simpler method shown at C. (The hoods, *l* and *o*, are required for appearance sake, the magnets being built of rough 2-inch slabs riveted together.) Messrs. Siemens employ a somewhat similar arrangement, and to ensure the pole pieces coming back exactly into position steady-pins are placed *horizontally* in the joint.

Fig. 6 shows the method adopted by Messrs. P. R. Jackson & Co., one of the pole pieces in this case being entirely removed and the armature slid out sideways. This firm's machines have the bed, bearing supports and magnets made in one piece of cast-steel. The castings come out rougher on the surface than cast-iron, and require more filling in when painted, but in all other respects the method is a very good one. Blow-holes, when they occur, are filled up by the Benardos arc welding process.

Fig. 7 indicates the hinged pole pieces as made by Messrs. T. Parker, Limited, the lower pole horns being of cast-iron, and forming part of the cover to the field coils. Messrs. Parker employ a somewhat similar construction in their undertype two-pole machines for coupling to high speed

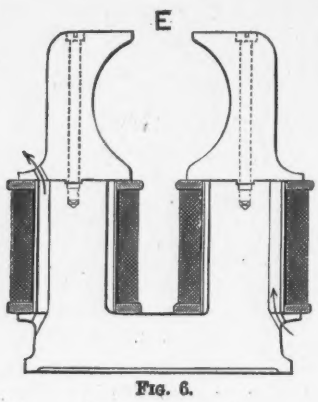



Fig. 6.

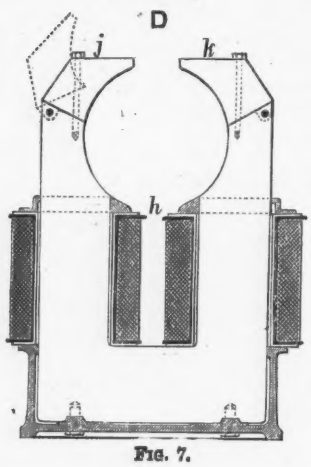



Fig. 7.

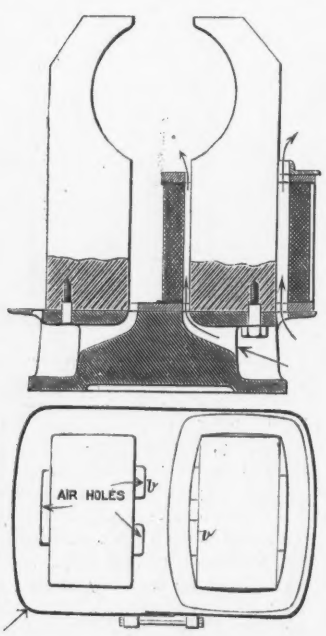



Fig. 8.

engines. Instead of supporting the magnets with gun-metal cantilever brackets (as introduced by Willans and Crompton and faithfully copied by almost every maker) they are carried on a strong ribbed gun-metal cradle which spans across from one side of the bed to the other. The pole pieces are cut through at the centre line, and the magnet forging with its coils, &c., can thus be lifted clear away, accurately-machined surfaces ensuring its coming back into position again.

In the smaller sizes of multipolar machine the top half of the yoke is first lifted away and then the armature, thus giving access to the lower field coils; but in the larger units of, say, 500 KW. and upwards, the weight and bulk of the parts become so great that it is found convenient to arrange for the field to slide along parallel to the shaft until the armature is uncovered, as is the common practice in alternator design.

It is sometimes convenient to surround the field magnet coils with planished steel sheeting, as shown in fig. 8. The temperature is raised somewhat, but this can be neutralised to a certain extent by arranging for air currents to pass up the inside of the coils as shown by the arrows. The inside air passages, *v v'*, also help to cool the armature.

*Slide Rails.*—With the increase in direct driving, slide rails are not so much used. In small machines, however, one still sees the barbarous ankle-breaking screw, having a projection on the slide casting to form the nut. Dogs are infinitely better, if for nothing else, because they don't project unnecessarily, but the most satisfactory arrangement is as sketched in fig. 9. The screw, in this case, may be used

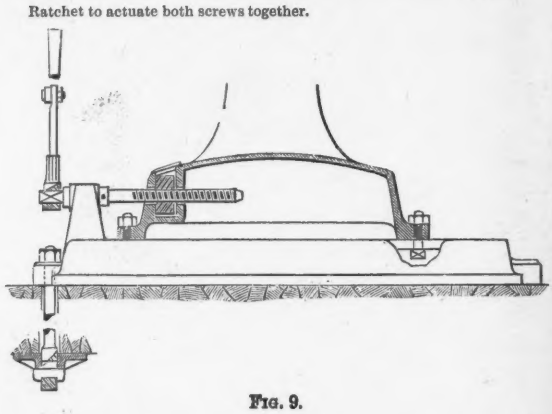



Fig. 9.

in tension as well as compression, and the belt or ropes can be readily tightened from the side remote from the engine. In America, where this type of slide is used extensively, the screws are actuated by two rachet handles, coupled together so that the bed moves parallel, and has not to be continually adjusted. Small machines have one screw, and V-grooves are employed to keep the machine moving parallel.

*Winding Cup.*—Oil creeping from the bearing has, in the past, been one of the most frequent causes of armature breakdown, for however many throwing grooves are employed, oil is always liable to creep. In order to make the contingency as remote as possible, it has for many years been the practice to carry the end windings of the armature of two-pole

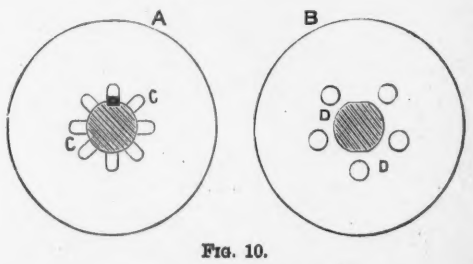



Fig. 10.

machines in separate cast-iron or brass winding cups, which completely enclose the windings at the ends of the armature core. These are used, for example, on the well-known Elwell-Parker machines, and the writer believes their use has had a great deal to do with the success of that particular type.

*Armature Core.*—It is common practice to fix the core

discs of drum armatures by a feather key (sometimes two), as shown at A in fig. 10. For a heavy shaft this is the best practice, but for small shaft the milling out weakens it, and the subsequent caulking in of the feather is liable to throw the shaft out of straight. As a matter of fact, a feather is not at all necessary if two good wide flats are planed on the shaft and the holes in the armature discs are stamped out as shown at B in fig. 10.

*Ventilation of Armature.*—A good many recent specifications have contained a clause requiring the armature to be internally ventilated, and in small two-pole machines one often sees attempts made at ventilation which, by unduly crowding the end connections and commutator, do more harm than good. It appears to the writer that it is only in the very largest two-pole machines (where the watts lost in the armature have increased at a greater ratio than the cooling surface), that arrangements for passing an air current into the interior of the core should be considered.

Air passages are sometimes arranged for by building the core on gun-metal spiders, but it is almost as good electrically, and certainly much cheaper, to carry the core discs right down to the shaft and provide for the air by punching holes or recesses as shown at C C and D D in fig. 10.

(*To be continued.*)

## ELECTRICALLY-DRIVEN JACKS.

The introduction of travelling cranes in locomotive works not already fitted with them, would in general involve a heavier outlay than would be commensurate with the advantages gained as compared with the use of jacks, hence these are still largely employed in many locomotive works.

At the locomotive works at Nippes, in Germany, each 12-ton jack is manned by five men. Thus, including the foreman, whose supervision is absolutely necessary to insure an equal movement of each jack, 21 men are required for the four jacks.

The time occupied in each lift is dependent upon the type of locomotive to be lifted, the height of the lift, and the capabilities of the workmen. On the average, about 45 minutes were taken up in lifting and 30 minutes in lowering a locomotive with four axles, but the variations in the time required, due to the willingness or unwillingness with which the men worked, led to the introduction of mechanical power for operating the jacks, and finally electric power was chosen. Rope driving was discarded on account of its many disadvantages. Compressed air, as well as electrical power, was available at the works, and both were tried, but it was found that in comparison with electrical gear the compressed air gear was complicated, and, moreover, the cost of the compressed air used was higher than that of the electrical energy consumed.

The 5-H.P. electric motor and necessary resistances are contained in a small car mounted on three wheels. The driving gear of the two jacks on the same side of the locomotive are connected to the "motor car" by means of solid spindles sliding in a hollow shaft on the feather and groove principle. A Hooke's joint is introduced to compensate for any inequalities in level. Motive power is supplied to the two jacks on the other side of the locomotive by means of chain gearing. The speed of the electric motor can be varied from 300 to 720 revolutions per minute by the introduction of resistances in the main circuit, and by altering the shunt resistance the speed can be further varied between 720 and 1,035 revolutions per minute. The power yielded at the lowest speeds is considerably reduced, but this is not a drawback, as the low speed is used when lowering the locomotive on to the axles when it is necessary to lower very slowly in order to facilitate the adjustment of the axle boxes between the horn blocks.

By this arrangement absolute evenness of lift is ensured by each jack simultaneously, and a considerable saving in time and in labour is effected. The time occupied in raising four coupled locomotives (requiring the highest lift) was 12 minutes, the same time being taken up in lowering. At 110 volts a current of 35 to 38 amperes was required for lifting, and 20 to 25 amperes for lowering. The labour employed, including shifting of "motor car" from one place to another, was supplied by two men.

The relative cost per operation of lifting and lowering would, therefore, appear to be as follows :—

*Hand Labour :—*

21 men for 75 minutes at, say, 5d. per man per hour ... 10s. 11d.

*Electric Driving :—*

Two men for 24 minutes, at, say, 5d. per man per hour ... 4d.

Energy used—

$$\frac{38 + 25}{2} \times \frac{24 \text{ minutes}}{60} \times 110 \text{ volts} = 1{,}386 \text{ watt-hours.}$$

At, say, 2d. per kilowatt-hour delivered ... ... ... ... 2¾d.

6¾d.

To this, of course, should be added something for interest and depreciation and cost of maintenance, but it is easily seen that even if this amount were taken at 1s. per hour, which would represent a fair value for interest and depreciation on a capital outlay of £600 after a fair deduction for maintenance, the saving effected would be nearly 10s. per lift and lower.

The figures given above are interesting also from the point of view of enabling a calculation to be made of the power exerted by workmen at Nippes. Here 38 amperes at 110 volts, or 4,180 watts, did the work of 20 men; but the work was done electrically in 12 minutes, whereas the men took 45 minutes, hence the average rate at which each man worked was

$$\frac{4{,}180}{746 \times 20} \times \frac{12}{45} = \text{nearly } 0{\cdot}075 \text{ H.P.}$$

## THE INSTITUTION OF ELECTRICAL ENGINEERS.

(*Continued from page* 264.)

Mr. Raworth, continuing, spoke of the standardisation of lathes and drilling machines, and even screw-drivers, in fact, all the tools used by an electrical engineer in his business, and he divided the question up into two parts: (*a*) the standardisation of governing factors, and (*b*) the standardisation of details. In the case of a railway the gauge is the governing factor, and to bring gauges into conformity entailed enormous cost and trouble. He and Mr. Mordey had done something at standardising periodicity, taking 100 periods p.s. Of course one had to take the periodicity the engineer gave as the standard in each case. Coming to the standardisation of details, Mr. Raworth agreed with Mr. Slater Lewis. He had found, however, that draughtsmen were prone to alter things as they went along, and cited an instance of a valve spindle ordered to suit an engine built a few years ago which was found to be $\frac{1}{32}$-inch out, a variation which was quite unnecessary and could mean nothing. Mr. Raworth concluded by making some dreadful suggestion that had reference to a cauldron of boiling oil for use by draughtsmen; a Gilbertian notion which called forth a protest from Mr. Kilburn Scott, who apparently took Mr. Raworth *au serieux*.

Mr. Mark Robinson reminded the meeting that his firm had standardised with some degree of success, but had taken a long time to do it. When the first order for a Willans engine was placed for a 4 H.P. size they had put half a dozen in hand, and had started the principle of standardisation from the very first. He might offer a few words of encouragement; there was really nothing in the paper to criticise. One could standardise not less or less perfectly than an American shop: the great thing was to really know one's own mind: the purchaser was only too glad to avail himself of anything really standardised; if the problem was attacked with the same determination and courage in this country as abroad, it would yield the same result. Some two years ago an engine of 1,200 H.P. was asked for. This was a very large advance upon what had been done, but a much larger sum was spent upon patterns, &c., than the price of that engine, and before the first was ready some 18 or 20 similar engines were on order. Mr. Robinson briefly touched upon Mr.

Blackburn's remarks, and with reference to Mr. Raworth's criticism of draughtsmen, said that he did not think there was any difficulty in insisting that unauthorised changes should not be made. Duplicates of everything ever made should be kept in store for replacement, however obsolete.

Mr. Hammond referred to the most interesting sentence —"That a condition precedent to the standardisation of plant is the standardisation of the buyer's engineer." He belonged to the class of gentlemen who, according to Mr. Sellon, would have to be standardised. He found the operation quite pleasant, and hoped it would go on. The writer seemed to think that the matter only concerned producers; it really concerned the industry at large. It was most important to get the best plant, and to get it most economically. The buyer's engineer had to do with spending capital, and nothing so much helped proper spending of capital as standardisation. The apparent diversity of periodicities, such as 83, 84·5, 87, 81, and 82, was due to all those plants having been intended for 10,000 periods per minute, but engineers in stations ran a little faster or a little slower, and gave the periodicity for the speed they each found most satisfactory. One admirably good suggestion was to back up the Institution Uniformity Committee. It has committed one act, and in beginning with transformers in houses, and recommending 100 periods, he thought one slip had been made. He felt it necessary to define in specifications what "plant" meant, as "all works and apparatus to be supplied under the contract." Engineers need not aim at brilliancy, but should see that manufacturers gave what they had contracted to give.

Mr. Ferranti stated that he had listened with exceptional interest to the paper, which affected not only the electrical engineering industry, but all the industry of this country. He was only sorry the paper was not read years ago. Much evil already perpetrated was unfortunately here to stay. He pointed out that the longer standardisation was delayed the greater would be the difficulties attached to it. Forty periodicity supply should be raised to 50 periods; in the United States formerly 120 periods was standard, but this had been varied and was now general at 60 periods. Some intermediate voltages had been chosen, and it had been suggested that such a choice enabled the spoilt lamps of other pressures to be used, but in this and other cases it was merely the argument of selfishness, and this is at the bottom of the trouble. People ask, "What difference will it make to me?"

On the resumption of the discussion on Thursday evening, the 22nd ult., the first speaker was Major-General Webber, who, while disclaiming any intention to add to the amusing side of the discussion, desired to refer to the American experience. In the United States there are large water powers, and the electrical units are only limited in size by previous experience of what is possible. Something of the same sort had happened with traction plant. The manufacture of large units had fallen into the hands of two or three firms with enormous capital, such as the Westinghouse and General Electric Companies, and competition disappeared. The manufacturer was kept in check by public opinion within the industry, and the heavy general charges were met by vastness of output. The standardisation of large units was not necessarily economical to the user. When the engineer wanted plant he casts about and examines the quality of manufacture, endurance, and so on of many manufacturers' articles made to many standards, and selects that most suited to his purpose. By excessive standardisation the export business is seriously affected. Large manufacturers standardise the public in a lamb-like way, and engineers are liable to become agents for monopolies—a sort of superior bagmen—as the outcome of non-competition. Makers had gone into standardisation of their own manufactures, as could be seen by comparison with price lists of, say, 1890, when in speed, output, and price there was small resemblance between different makers. Then one was liable to be bewildered over the variety offered, and an immense amount of capital was wasted. The condition of things naturally led to a variety of discounts. The Brush Company got nearer to standardisation with their 60-light arc lighter than was the case with incandescence machines. Some people mistakenly looked to Government departments. Major-Gen. Webber went into this point at some length, and showed how necessarily the War Office, for example, could not adopt a standard form of projector. With guns it was rather different owing to the quantity required before a pattern had time to be superseded. He referred to the Admiralty specification for dynamos as an example of reasonable standardisation which had assisted the industry by clearly stating what was required and what it would have to do. Everything that tends to organised standardisation in the industry he considered wholesome, and he thought the members might urge the Council of the Institution from time to time to appoint Committees like the "Wiring Rules" Committee.

Mr. Esson thought that all must agree that the subject of standardisation is extremely important, and if we are going to give the customer the best value for his money we must have standardisation, but it seemed that there were great difficulties in the way and great diversities of opinion as to how it is to be obtained. There were two questions—(*a*) the standardisation of machines, &c., of different firms making similar appliances; and (*b*) the standardisation of the manufactures of any one firm. There did not appear to be greater standardisation on the Continent or United States, for while, no doubt, *in the works* this is carried out much more generally than in this country, American machines seemed to have no greater fixity of type, but only a larger number of machines of each batch were constructed before the pattern was altered. He agreed with Mr. Slater Lewis that if electrical engineers in this country instead of running the gamut, as it were, of sizes and types, could confine themselves to one or two patterns, a great reduction in cost would result, but no one firm has enough business in any one thing to keep it going. He believed that some day it must come to combination, and then one firm would make alternators, another specialise on lamps, a third confine itself to motors and so on. He never knew a consulting engineer who would not accept a good thing out of stock rather than invent a specification for it, and consulting engineers were "very useful at times; a living compendium of all the mistakes made by contractors." It was very difficult to specify the ends to be obtained without specifying something about the means, because it was by the latter that durability was ensured. For example, a 440-volt dynamo might be specified to stand 1,000 volts for an hour or half-an-hour, as the case may be; he had known such a machine called to withstand 5,000 volts for an hour—of course, such a test was beyond reason. He took it that standardisation was not so much for small plants as those for central station use. Engineers might begin by agreeing on questions of two or three-crank engines, whether triple or compound; dynamo makers had generally, in this country, to buy the engines, as it was cheaper to adapt the dynamo to the engine than the engine to the dynamo. He thought that in fixing a standard frequency an attempt was being made to begin at the wrong end. In the United States, where belt or rope driving was common, the frequency could be altered by simply changing the driving pulley, and in Switzerland, where water-power was largely used the turbines were easily altered to suit the frequency. Within wide limits, the frequency had little effect on efficiency, and between 40 and 60 periods p.s. transformers would work well. Thus the electrical engineers on the Continent had no hard and fast frequency, but if a 120-KW. alternator was wanted they took one built for 100 KW, and ran the speed up, and therefore used a rather higher frequency. Mr. Raworth had compared periodicity to railway gauge, but the importance of railway gauge is owing to through traffic. There are four separate systems to be traversed in going from London to Aberdeen, but there is no analogous case of connecting the electricity supply systems of Edinburgh and Newcastle. It is relatively easy to alter the winding of the stators of motors or the coils of arc lamps. When standardising, let us standardise the right thing. He thought that fixing the periodicity hard and fast defeated the object in view.

Mr. Evershed supposed that most engineers agreed that standardisation was desirable, how it was to be arrived at was quite another matter. The standardisation of engineers was a necessary preliminary. It was not an isolated instance of something unpleasant one wanted to remove; it was only one instance of a temperament growing in Great Britain. Now no new industry could be started without rules and acts to regulate it in every possible and often impossible way. The evil was widespread and spreading every day.

Hastings, for example, insisted that one might not "play upon a musical instrument or performing animal in the streets!" He thought with Mr. Blackburn that manufacturers could begin at home, and he had attempted in a humble way to standardise instruments, but the experience had been disheartening. He cited instances of instruments being expected to do everything, to stand on their terminals, indicators to show direction of current without permanent magnets, of scales being required to be read to 2 per cent. accuracy at any part. Not only impossible conditions are prescribed, but absurd requirements are given of accuracy, and specifications ought certainly to be standardised in this respect. As a result of such varied specifications, consulting engineers are keeping up the price of instruments abnormally for alterations to an instrument costing a few pounds, may involve modifying patterns costing a great deal more. He thought that manufacturers by meeting together, might settle the limits of accuracy.

Mr. Leonard Andrews had seriously thought of getting into line by adopting modern standards of frequency, but had been met by the remark that the confidence of ratepayers in the undertaking would be shaken if a station recently taken over by the municipality had to scrap its alternators, even if the change would probably pay.

Mr. Stuart Russell thought that the author of the paper, by laying stress upon sizes, had begun at the wrong end. Engine makers had the start, and they cannot now be asked to change. There was no advantage in all manufacturers making exactly the same sizes of machines. The fixing of a standard pressure would be an advantage; we had accepted the standard pressure for traction from America, and as machines are in some stations used for both traction and lighting, it meant that a nominal 200-KW. dynamo had really to be a 250 or 260-KW. machine to stand the overloads and give the specified current and pressure output for both purposes, although coupled to only a 200-KW. engine, and thus the user could not make use of the full output of the dynamo. In cases where it was specified that the current overload was to be given at 440 volts, a so-called 200-KW. machine was really nearer a 300-KW. dynamo, according to design. The heating of machines might be standardised, as the rating of machines is vague; if a decision could be come to that a 50-KW. machine was one which gave 50 KW. for so long at such a temperature, something would be gained. Mr. Russell then dealt with the figures of 50°, 70°, and even 90° F. rise of temperature specified; with the insulation resistance asked for reaching 10 megohms in some specifications, a value never maintained under ordinary working conditions; and then there was the high pressure test already alluded to by another speaker. A very useful start might be made on these minor matters. On constructional details, he said, there are many cases where no good purpose is served by specifying something varying from usual practice—the number and width of brushes, for example—as such changes cannot make very much difference in results to be obtained. There is sometimes also a temptation to comply with a specification at a loss to the user, say, if bearings are specified four times in length the diameter of the shaft and the usual practice is 11 inches long by 3 inches diameter, the figures may be made 11 inches long by $2\frac{3}{4}$ inches diameter rather than 12 inches long by the original diameter of 3 inches.

Mr. L. Birks believed that frequency was standardising itself, while Mr. A. E. Levin remarked that, so far from the Continent being a terrestrial paradise as regarded standardisation, there one does not even find a standard system of screw threads. Although the frequency is usually low, there is by no means actual uniformity. He ventured to differ from Mr. Esson when it was stated that the question of periodicity was not a very serious one. It hampers small motors. Standardisation must begin with large and not small plant, as the large creates a market for small plant, probably exceeding in value that of the generator. He thought the general adoption of 50 periods p.s. a healthy sign.

Mr. Addenbrooke said that the Institution should not have defined periodicity with the strictness it has done, as we might arrive at conclusions with the increase of knowledge that may alter the conception of the "best frequency." He could not avoid the idea that the progress of electrical industry in this country has not been normal; it had been forced out of its natural lines by legislative action. He made some plain and straightforward remarks about "young men just out of the works" being put in responsible positions and given authority to select plant, thinking the "consulting engineer superfluous," but the time would probably come again when matured and skilled advice would be wanted in that most difficult of things, the selection of the best plant to meet the customer's requirements.

Mr. C. E. Grove pointed out that there were several kinds of standardisation spoken of in the paper. Specialisation is totally distinct from standardisation. One found a good deal of human nature in this question, and there lay the difficulty. Knowledge and opinions were different things; it was not only a question of mere fact; facts, equally at the disposal of different engineers, caused them to arrive at different conclusions. The manufacturer can and does standardise those parts more or less invariable. As to specialisation, there is much to be done advantageous to everybody.

Prof. Ayrton did not agree with Mr. Esson in thinking that America was like England in having no standardisation. This arises out of misunderstanding the American system. Standardisation, from the United States point of view, did not mean no progress; it only meant that at any one time there was only one type of machine which the makers would not alter or change for anybody, but that type from time to time was modified and improved, because the factory was always making experiments. It was similar to watch manufacture at Coventry, where five sizes were made, and no more. Mr. Raworth and others had pointed out that the consulting engineer asked for all sorts of different details, this arose from the fact that the manufacturer did not say what the properties were in every detail of his machine. Standardisation was not stagnation: it was Conservative Radicalism.

Mr. Stephen Sellon was particularly caustic about those who derided the consulting engineer. It appeared as if consulting engineers were banded together in an unholy league to prevent standardisation of electrical plant: like a voice in the wilderness one hears the call, "Mr. Consulting Engineer, if you have come to stop, will you please let me standardise?" What has the consulting engineer to do with standardisation: they might be quite sure that the consulting engineer would adopt a good standard article, but some of those who talked most had not, and "never will have anything worth standardising." What had to be quite clear was, that plant purchased had gone beyond the experimental stage. Many mistakes had been made in traction work; no manufacturers were ready for traction where it began in this country. Again, look at the large works employing plant of Continental design—why was this? Because the manufacturer had neglected to take advice and experience of the consultant. The consultant comes in to procure the confidence of the public for whom his client is catering. The time may come when the continuous current machine may depart and three-phase working take its place.

Mr. J. E. Kingsbury thought that Mr. R. P. Sellon was generous to consultants, but he seemed to be trying to arrive at standardisation the wrong way. American standardisation was standardisation of supply; Mr. Sellon attempted to standardise the demand. He thought it would be advantageous if there were just a little more conference between engineer and manufacturer than seemed to exist here.

Mr. R. P. Sellon, having been called upon for his reply, said the essential points brought out in discussion were—(1) Whether standardisation were a backward movement relatively to rival methods; (2) whether it were desirable; and (3) practicable; and if so (4) whether the Institution ought to take any part in the matter. He thought the fairest interpretation of the meaning of standardisation was such agreement among buyers as to ends as would enable manufacturers to go in for quantitative manufacture. He thought that in that it was agreed that we are not so advanced here. Gen. Webber had thrown doubts upon the interests of consumers being assisted by standardisation, he ventured to traverse that statement. The great competition between rival concerns, or combines even, in the United States, led to standardisation being in the consumers' interests. We were at the dawn of electric traction work and power distribution in this country. Now was the time to deal with these problems before it be too late. He thought that the absence of standardisation was in a

great measure to be placed at the door of the manufacturer, who had dallied, and had not said to the buyer "You can take this standard article or leave it." If it appeared in the paper that he had been unfair, his desire was not to bring forward in a paper such matters, but every manufacturer would gladly acknowledge the debt that the industry was under to such men as Dr. Hopkinson and other consulting engineers, who, like him, had given great assistance and guidance to manufacturers. There was no hope of success for standardisation unless approached with willing mind by both manufacturer and engineer. His paper had not been put forward from any sectional point of view. All would be thoroughly alive to the crisis through which the industry was passing in this country. To attempt to deal with the deep seated problems leading up to this, would probably have led to a discussion which would have been rather academic than practical, but he urged standardisation as being for the advantage of the electrical industry at large. Thus the discussion closed.

## CORRESPONDENCE.

### Lamps.

Some time ago you made some remarks about a letter to the *Times* on the subject of a lamp bursting.

Yesterday evening one burst suddenly in my sitting room —a 25-c p. 120-volt lamp.

This lamp had been in use eight or nine months, and had been alight on the evening in question about half an hour, when it suddenly burst, scattering the fragments of glass all over the room.

Nothing had touched it! I presume that some chemical change had been taking place in the air, or remnant of air, in the bulb, or some gas must have been slowly forming off the filament until the pressure got too strong for the glass.

You ridiculed the idea of a lamp bursting spontaneously; this is a case which is convincing.

J. E. Ritter.

Limavady, *February 24th*, 1900.

[We have never "ridiculed the idea" of a lamp collapsing spontaneously; but we do smile at the idea of a glow lamp bursting from *internal pressure!* Our remarks applied to the switching-on of 200-volt lamps.—Eds. Elec. Rev.]

### Carbon Anodes.

I would be obliged if any of your readers who may have had experience with carbon anodes in sulphate of copper solutions containing free acid will give the result of their experience. Does this material disintegrate, or is it attacked by the free oxygen?

G. W.

Swansea, *February 26th*, 1900.

### The Wiring of Houses for the Electric Light.

Referring to Mr. de Segundo's article under the above heading in your issue of last week, I was much interested in his remarks about joints. He does not, however, tell us how the joints in a system of unlined piping should be insulated, assuming that some joints are necessary and that they cannot be mechanical ones. (By the latter term I presume he means some form of set screw and terminal.)

In the two or three systems of bare conduit now on the market, joint boxes are provided without any lining and with no terminal blocks, and it is my contention that unvulcanised joints in such boxes will sooner or later break down, as their insulation is much less than that of the wires which they join. It is of course possible to vulcanise the joints, but how few contractors would be conscientious enough to do this (I only know of one), unless the job is a very large one, or the consulting engineer has specified it!

I recently had the consulting for a small extension on a 200-volt supply in which it was impossible to dispense entirely with joints. The wires were run in Simplex conduit, and all the joints for each circuit were collected in a bitumenised *wooden* box, made by a joiner on the spot, and let flush into the brick wall, the conduits from the different points entering this box wherever convenient. I think this is much safer than putting the joints in a metallic box, because all danger of leakage to earth is obviated, and the joints can be so arranged in a roomy box that short-circuiting would also be impossible.

V. Zingler.

### Electrostatic Measuring Instruments.

With reference to the article on "Electrostatic Measuring Instruments" in your last week's issue, I note that according to your own figures if for a given voltage and with similar scales an instrument gives *five (5) times* the deflection which the other does, you consider the two "to be about the same order of sensitiveness."

I note also that if a capacity of the $\frac{1}{100000}$th of a microfarad is connected across an alternating circuit of 800 periodicity through a resistance of 10 ohms when the impressed E.M.F. is about $\frac{1}{2}$ volt, the capacity "is charged only to $\frac{1}{50}$th of the impressed voltage."

If you should have to answer this question in a Central Institution paper, I would strongly advise you to try another solution and in ordinary units. When people begin to play with C.G.S. units there is a danger of a string of O's going astray, which is liable to make some difference in the character of the answer.

$\frac{1}{100000}$th of a microfarad is not $10^{-12}$ as you give it, but $10^{-20}$, if you wish it in this form. Your answer divided by 100,000,000 is probably not very far out, but the change has rather an unfortunate effect on the rest of your reasoning.

As regards your remarks on my instruments, I am content to leave the instruments to take care of themselves.

I cannot, however, pass your somewhat airy assertion that while the electrical problems connected with electrometers are complicated, the mechanical problems are simple and attractive. I thought the exact converse was the general opinion, namely, that the electrical problems connected with the electrometer were so simple as compared with those involved in using other classes of instruments, particularly for alternating currents, that the instrument would largely be employed if only the mechanical problems involved could be satisfactorily solved.

You are quite right that it would be a good thing if some one would write a book on the use of electrostatic instruments.

*Pro* G. L. Addenbrooke.
A. K. T.

[In the account of the instrument before us, when the article referred to was written, the only datum of the sensitiveness was that voltages as low as $\frac{1}{10}$th of a volt could be detected, and our comparison was made on this basis. The general conclusion that Mr. Addenbrooke's instrument is of the same order of sensitiveness as others seems to be justified by his figure. In considering a range of measuring instruments, two instruments, one of which requires 2·24 the voltage for a given deflection that the other does, would be classed as of the same order of sensitiveness. We attributed little importance to this comparison and the difference is only one of language.

Mr. Addenbrooke is right as to the error in the expression used by us for the capacity of the instrument. There should be no error due to the strip till frequencies far beyond any ordinary experiments are reached.

The electrical problems connected with the design of electrostatic instruments are, we venture to think, exceedingly difficult, and it is much harder to calculate the behaviour of any new form of instrument from the data of a previous one than is generally the case with magnetic instruments. The problems connected with their use are of course much simpler. It was their construction and design rather than their use that was to be dealt with in the book we contemplated.—Eds. Elec. Rev.]

### Quality of Steam.

Will you allow me space to repeat the details of a process, which I proposed some years ago in the columns of one of your contemporaries, for the purification of water? The water is run into a tank and then treated with the silicofluoride of ammonium, until it is acid to litmus. More water is then added, until the litmus is restored to its original colour.

The effect of this operation is to precipitate all the lime, soda, potash, magnesia, and other salts which may be in the water; at the same time corresponding salts of ammonium are produced. The chief of these will necessarily be the carbonate, which is volatile at the ordinary atmospheric pressure; but, under the influence of heat and a higher pressure, is converted into other non-volatile products.

The precipitate would have a commercial value if procurable in large quantities; in any event the process is inexpensive, and seems to me to give steam users precisely the quality of water they require. I may add that there is no patent to pay for.

W. Mills.

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### Libel Action Dismissed.

It may interest your readers to learn that the action for libel that the National Conduit and Cable Company, of New York, commenced against us last year in the matter of a letter we wrote to your paper as to the way in which the cable contract for the Dublin Tramways was let, has now been finally dismissed for want of prosecution.

We inform you of this in justice to ourselves, as the taking of this action against us was published at the time. Further comment on our part is needless.

British Insulated Wire Company.
G. H. Nisbett.

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## LEGAL.

### Goldberg *v.* Liverpool Corporation.

The *Liverpool Mercury* reports at considerable length the case of J. Goldberg & Son, tobacco and fancy goods dealers, Paradise Street, Liverpool, against the Corporation of Liverpool. The case was heard in the Chancery Court of Lancashire last week before Vice-Chancellor Hall. It seems that the defendants have fixed a pole and fuse box for the electric trolley wire in Paradise Street in front of the entrance to the plaintiff company's premises, at the junction of Paradise Street and College Lane. In their action, plaintiffs claim (1) an order on the defendants to pull down and remove the said tramway pole and fuse box, (2) damages, and (3) costs. The plaintiffs hold their premises on lease from the Corporation for 75 years from 1883, and in their statement of claim they say, in effect, that having refused (as they were admittedly entitled to do) permission to the Corporation to fix on their premises a "rosette" for supporting the electric span wire at that point, the Corporation shortly afterwards erected on the footpath in front of plaintiffs' corner and main business entrance a tramway pole, and subsequently (after the plaintiffs had complained of the position of the pole) a fuse box of 2 feet 6 inches by 1 foot 9 inches and 3 feet 4 inches high, the pole being only 3 feet 2 inches from the entrance and nearly facing it, and the fuse box, connected with the pole, 2 feet 6 inches from the entrance. These positions of the pole and the fuse box the plaintiffs claim have not been selected on the grounds of "expediency or necessity," but with a view of putting pressure upon the plaintiffs so as to drive them to consent to the fixing of the proposed rosette. From the obstruction of entrance to and of egress from their premises by the exceptional position of the pole and fuse box and by the attraction of loiterers, the plaintiffs allege that they have suffered considerable damage, which will continue until the pole and fuse box are removed to a more convenient position.

When the case came on on 21st ult. Mr. Mattinson opened for the plaintiffs, and a good deal of discussion arose between himself, Mr. Maberley, for the defence, and the Vice-Chancellor. Mr. Maberley proceeded to call witnesses for the defence, the first being Mr. J. A. Brodie, the city engineer. He said the location of the supports of the wires in Paradise Street was settled, by his own survey, before it was decided whether centre poles, side poles, or rosettes, with the alternative of pavement poles, should be fixed. The question of rosettes had not even been raised when the supports were marked on the plans. The supports were chosen at the best practicable intervals, and afterwards adhered to. Centre poles having been rejected, side poles were contemplated, but witness found, on having trial holes made, that the position near the kerbstone of a gas company's main, electric mains, a water main, and connecting sewers, rendered poles by the side of the kerb impracticable. It was then that rosettes in corresponding positions were proposed, but as plaintiffs objected as to their premises, while two other buildings were found unsuitable for rosettes, several poles had to be erected on the pavement. On receiving, as regarded the proposed rosette, the refusal of the plaintiffs, dated February 15th last year, he immediately endorsed the letter, "Pole to be planted." He had previously shown the contractors' engineer (Mr. Higginson) where the pole must be placed, and though it was actually planted a few inches away from the spot witness indicated, the slight variation was in favour of the plaintiffs, and was made in the exercise of Mr. Higginson's discretion. To have further changed the position of the pole would have necessitated the re-erection of the rosette on the opposite side of the street, and witness did not think the owners there would have been likely to agree to a second interference with their premises. Witness explained that he could not have erected the pole and box close to the blank wall of the plaintiffs' premises a little way up College Lane, because that would have interfered with their "footings" and basement. The electric pole could not be placed "in or near the position of the gas lamp-post," as plaintiffs had suggested, because of the gas main beneath, which was about 2 feet in outside diameter. He would not take a personal responsibility for placing the pole and fuse box, as now tentatively suggested, right in the line of the foot traffic of Paradise Street. He did not think the pole and box in their present position materially affected the plaintiffs' premises. He adopted the position for the pole and box in the general interests of the city, and without any question of the frontager. He had fixed the intervals of the poles on his original survey.

The hearing extended over a number of days, and his Lordship intimated that he will deliver judgment on Monday next.

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### National Free Wiring Company *v.* Lambert.

In the Westminster County Court on Thursday last week, his Honour, Judge Lumley Smith, Q.C., and a Jury, had before them an action by the National Free Wiring Company, Limited, to recover £19 odd for fittings supplied to the defendant, Henry Austin Lambert, the proprietor of the Jolly Sailors, Lower Road, Rotherhithe.

Plaintiffs' case was that they were in the habit of wiring premises and supplying fittings for the purposes of the electric light, but if special fittings were required, they were to be paid for, the other fittings being supplied on a rental of ¾d. per unit of electricity supplied each quarter. There was also a charge of £10 for altering gasoliers to electroliers. The electricity was supplied by the London Electric Supply Corporation, Limited, and they collected the rental. Some time after they removed the fittings, some of which they now had.

In cross-examination, plaintiffs' cashier admitted they had a man named Collins, who was a canvasser, and he obtained the orders. He was not now present. Circulars were distributed by the corporation, one of which was produced, stating that after two hours electricity only cost 3d. per unit, which was equal to 1s. 9d. per 1,000 feet of gas.

Mr. Given, defendant's counsel, said if the contract was entered into in consequence of the misrepresentation of the defendant's canvasser, then he thought the jury would set it aside. When Collins first called Mr. Lambert refused to have anything to do with the electric light, but subsequently he told him that it would be very much cheaper than gas. To that Mr. Lambert said, "Why should I change?" to which he replied that it was so much cheaper, and he gave him the corporation's circular, which stated that the cost would be but 3d. per unit after 1½ hours. Now what was the result? The gas bill for the quarter previous was £70, and the electricity bill from February to October was £120. After that he had the fittings removed.

Defendant bore this out on oath, and said not only was the light much more expensive, but it was not so good as the gas, and he had spent £40 in going back to the gas. He would never have entered into the agreement, but for the fact that it was urged it was so much cheaper.

Plaintiffs' solicitor pointed out that the circular of the corporation stated that the cost per unit was 6d., and several months had elapsed between the first call of Collins and the time the contract was entered into. The 3d. related to power for motors, and the scale for light did not go beyond 5d.

His Honour failed to see why the 3d. should be put in the circular. Everyone knew that the electric light was dearer than gas. People grumbled that the gas was not good, and that electric light was dear. He knew of no one who paid less than 6d. a unit.

Mr. Given wanted to call a number of traders to give similar evidence of the great increase in the cost of electricity against gas, but this his Honour declined to allow, and in addressing the jury told them that if the contract was entered into in consequence of the fraudulent statements made by Collins, then it could be set aside. It was for the jury to say whether it had been proved to their satisfaction. Everyone knew electric light was dearer than gas.

The jury found for the plaintiffs for £10, apparently for the alteration to the gasoliers.

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### London Electric Omnibus Company *v.* Neill

Before Mr. Justice Ridley and a special jury in the Queen's Bench Division on Monday the case of London Electric Omnibus Company *v.* Neill came on for trial. This was an action by the plaintiff company to recover calls on shares. It was not denied that the calls were due, but the defendant alleged material misrepresentation in the prospectus, and counterclaimed against the company for recission of contract, and against the directors for damages. The alleged misrepresentation was denied.

Mr. Dickens, Q.C., and Mr. J. Eldon Bankes appeared for the London Electric Omnibus Company and for Major S. Flood Page, Mr. T. Sutton Flack and Mr. J. B. W. Maunder, directors of the company, and defendants on the counterclaim; Mr. Beddall represented Mr. Henry Fox; Mr. Boxall, Mr. Radcliffe Ward; and Mr. Witt, Q.C., and Mr. Kimber appeared for Mr. William Mayne Neill, the defendant in the action.

Mr. Witt opened the case for the plaintiff on the counterclaim, observing that the company was incorporated in 1896, to put on the

London streets omnibuses propelled by electricity, its nominal capital being £250,000, of which shares for £100,000 were offered. Plaintiff applied for and obtained 240 shares of £1 each, 10s. being paid up. In the prospectus there were the material misrepresentations which were relied upon. At the head of the document there was a picture of the omnibus, which it was said carried 26 passengers, and had been designed by Mr. Ward for the company. This was followed by a paragraph which said "A contract has been entered into with the Crystal Palace Company to run in the grounds, carrying passengers, a new type of omnibus similar to those about to be run in the streets. Omnibuses are now to be seen at the Crystal Palace which will be carrying passengers shortly." This assertion was designed to obtain public confidence; but the facts were that there never was a finished motor omnibus at the Crystal Palace, or one which could carry passengers, but only the body of a bus which had neither wheels nor motor parts. The invention was next puffed up as "a sound, progressive, industrial, British enterprise," and it was added, "The electric omnibus designed by Mr. Ward has run upwards of 5,000 miles on the London streets through the most crowded traffic with complete success, and has proved as noiseless as a horseless carriage fitted with pneumatic tyres." So far from this being the fact, the company had never put an omnibus on the London streets, had never carried a passenger for hire, had never done any business at all, but had spent the whole of its money, except what had been handed over to Ward for the purchase of some patents which counsel believed had lapsed in experiments and demonstrations, so that at last they had in the bank a sum of £1 19s. 1d., and had got rid of £37,000 odd in experiments, salaries, and payments to Ward.

Mr. William Marshall, a mining engineer, said he was promoter of the company, in conjunction with Mr. Radcliffe Ward, and one of its directors. An arrangement had been made by Mr. Ward with reference to the running of an omnibus at the Crystal Palace. He did not recollect seeing any contract with the Crystal Palace Company for running the omnibus there, but there was a letter. There had been no omnibus at the Palace capable of running when the prospectus was issued, but there was the body of the 'bus, showing Mr. Ward's design, but it had no motor power or wheels, and also an older design by Mr. Ward, but it had been brought down by horses; he had not seen it run. The directors believed and trusted Mr. Ward's statement, and expected that it would be running in the grounds. Mr. Ward's omnibus shown at the Crystal Palace without wheels was completed five months later, and carried over 26 passengers on a trial trip; they were at one time hanging round it like rats. It was a most successful trial, but the motor omnibus stuck a few days afterwards, and had to be drawn home by horses. There had been no other successful run. They had never carried passengers for hire.

What do you say to the statement in the prospectus that the omnibus has been run 5,000 miles through the most crowded traffic in the London streets?—I say that was one of the statements made by Mr. Ward that induced me to go in for the scheme. Afterwards I considered the statement was absolutely untrue. If Mr. Ward had been able to run the omnibus 5,000 miles, we should have been assured of a gigantic success.

Questioned further, the Witness said the company principally spent its money on experiments and directors' fees.

By Mr. Dickens: He could not say whether the directors had not drawn any fees since November, 1896. Mr. Radcliffe Ward had largely interested himself in mechanical traction, and told witness that he had run an experimental car for four years successfully. The directors had favourable reports on their omnibus from Mr. Spagnoletti, the consulting electrical engineer, and Messrs. Imray, patent agents. They had a letter from Mr. Gillman, of the Crystal Palace, saying his company would be glad for Ward's omnibus to be sent on to the International Horseless Carriage Exhibition being held there, the company to take 50 per cent. of the receipts.

Mr. Justice Ridley considered the letter did not constitute a contract.

Witness declared that the directors were misled altogether by Mr. Ward as to the power of his omnibus, and so entered into a contract expecting to do what was impossible.

Mr. W. M. Neill, the defendant in the action, and a Mincing Lane merchant, said that when applying for shares he was greatly influenced by the statement in the prospectus that the omnibus had been run 5,000 miles in the thick of the London traffic, which he considered would prove it to be a valuable commercial property.

Cross-examined by Mr. Dickens: Until he was sued for calls he never suggested that he had been defrauded. At the shareholders' meeting on March 4th, 1898, he did not suggest misrepresentation, because he understood another shareholder was bringing an action, and wished to see the result.

This was the defendant's case.

Mr. Dickens submitted that no claim was made out for revision of the contract, owing to the delay in bringing the action, though these matters had been known to Mr. Neill for years. Also that fraudulent misrepresentation had not been made out, the evidence showing that the directors *bonâ fide* believed in Mr. Ward's representations to them.

Mr. Dickens, addressing the jury, said that the defendant did not take these shares as an ordinary investor, but as an underwriting contract, under which he was to obtain 15 per cent. commission. It was on him to show that before he entered into the underwriting letter he saw the prospectus which he said misled him, but, as a fact, the paragraph relating to the Crystal Palace was not in the prospectus at the date of the letter. The directors regarded the arrangement with the Crystal Palace Company as a contract, and it was so entered in their minute book. It was the fact that a car on Mr. Ward's earlier design had been run for upwards of 5,000 miles in the London streets, and this design was being improved upon in the company's omnibus. With regard to the substance of the prospectus, an independent committee of shareholders had declared it to be absolutely accurate. The defendant had no quarrel with that report, which was adopted by the shareholders, and now, after these years of delay, brought this action, not upon the real substance of the prospectus, which he ignored, but fixing upon three small references, which counsel asked the jury to say contained no misrepresentation at all.

Major Flood Page, a director, testified generally to the *bonâ fides* of the directors in the statements they had made and their reliance upon the reports of Mr. Ward. If only the default made on shares—£15,000—could be made good, he still believed the company could be turned into a success.

By Mr. Witt: The company paid £20,000 to Ward and Marshall for the patents and promotion, and spent money on experiments and demonstrations.

Have you ever manufactured more than this one omnibus?—I think three or four, but am not sure, they have been so much altered.

Mr. J. B. W. Maunder, another director, was also examined, and the further hearing was adjourned.

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On the hearing being resumed on Tuesday,

Mr. Radcliffe Ward, one of the directors of the London Electric Omnibus Company, and inventor of the patented electric omnibus, said he carried on the business of an electrical engineer in Northumberland Avenue, and since 1882 had largely interested himself in electric traction. He had constructed an electric omnibus before this company was formed, which for four years had been run successfully on the London streets. It had covered not only the 5,000 miles mentioned in the prospectus, but, he thought, something nearer 10,000 miles, and the omnibus was in existence when the company came out. In May, 1896, a new bus was in process of construction, which it was intended to exhibit at the Crystal Palace, and it was anticipated that the wheels and attachments would be ready in ample time. As to the other car—the 26-passenger car—sent down to the Palace, it was fully complete, and had been tested; it ran successfully, but owing to difficulty about floor space, it was decided only to show it as an exhibition car. The first car was ultimately completed, and was constantly run on the London streets; it was the best car of the kind that had been built.

Mr. Justice Ridley said he would not have the Court further used for advertising this company.

Witness added that at the time the statements were made in the prospectus, he honestly believed that they were true, and that he had reasonable ground for so believing. At the time the paragraph was inserted in the prospectus, "A contract has been entered into with the Crystal Palace," &c., he thoroughly believed, as did all the directors, that Mr. Gillman's letter constituted a contract.

Mr. Gillman, manager of the Crystal Palace, gave evidence as to the arrangement he completed for the exhibition and running of the plaintiff company's electrical omnibus in the Palace grounds; and Mr. Alexander Schenschell also testified on the same point.

This completed the plaintiffs' case.

Mr. Justice Ridley ruled that the defendant was debarred by the delay in bringing his action from any right to recission of his contract. He left it to the jury to consider (1) whether the defendant was induced to buy the shares and subscribe to the company by the alleged misrepresentations in the prospectus; (2) whether or not the statements relied upon in the prospectus were true; and (3) if untrue, had the directors reasonable grounds for believing the statements, and did they believe them when they were made.

The jury found that the defendant was not influenced by any misleading statements in the prospectus, and that the statements in question could not be regarded as untrue.

Judgment was entered for the plaintiffs for £129 interest on the claim for calls, and for the defendants (the directors) on the counterclaim.

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### Airey *v.* The Corporation of Liverpool.

This was an action brought before the Liverpool Assizes last week to recover damages from the Corporation of Liverpool for injuries sustained as a result of a collision between an omnibus and an electric car at the corner of Grove Street and Upper Parliament Street on October 16th. The jury awarded the plaintiff £170 damages.

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### Musker *v.* Riverside Cold Storage and Ice Company.

At the Liverpool Assizes last week, before Mr. Justice Grantham, without a jury, this action was brought to recover the balance of the contract price in connection with the supply of electric lifts and hoists, and also for some extras. When the case had been in progress some time a consultation took place, and his Lordship was informed that it had been arranged between the parties that judgment should be entered for the plaintiffs for £227 and the counterclaim struck out.

His Lordship gave judgment accordingly.

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### The Doe Portable Power Syndicate.

Mr. Justice Phillimore, sitting in the Queen's Bench Division without a jury to-day, heard the case of the Doe Portable Power Syndicate *v.* Clarke, which was an action to recover £150 on a guarantee or agreement to pay money when called on.

Mr. Llewellyn Davies appeared for the plaintiff syndicate, and Mr. Dodd for the defendant.

Mr. Davies read the indenture setting forth the formation of the

syndicate for the fact that they had acquired certain English patents and contracted to buy certain Colonial patents for £2,000. Certain persons, of whom the defendant was one, agreed to guarantee to the syndicate the repayment of this sum within 14 days after receiving a request. The share of the defendant was £250. If a certain amount of capital was subscribed or profit made, the guarantors were to be repaid. Their liability absolutely ceased at the expiration of six months. The indenture was dated December 7th, and notice was given on May 10th, 1899, well within the six months. No notice was taken of the application, and after other applications had been made, the writ was issued, though this only took place after expiration of the six months.

The defence was that the agreement had come to an end by fluxion of time, and that this was a covenant to lend money, and that an action for debt did not lie.

His Lordship gave judgment for the plaintiffs. The fact of the six months running out before the issue of the writ was no reason why plaintiffs should not recover. The indenture was not a covenant to lend money, but a recognition of a debt, and an action for debt did properly lie.

## BUSINESS NOTES.

### Electrical Wares Exported.

| Week ending Feb. 21st, 1899. | | Week ending Feb. 20th, 1900. | |
|---|---|---|---|
| Adelaide | Value £104 | Adelaide. Teleg. app'ratus. | Value £300 |
| Amsterdam | 25 | Alexandria | 26 |
| Beira | 65 | Boca | 269 |
| Bilbao | 50 | Bombay | 70 |
| Bombay | 120 | Buenos Ayres | 35 |
| " Teleph. stores | 12 | Calcutta | 218 |
| Brisbane. Teleg. mat. | 1,976 | Christiania. Teleg. wire | 48 |
| " Teleph. stores | 296 | Colombo. Teleg. mat. | 467 |
| Buenos Ayres | 438 | Constantinople | 48 |
| Calcutta | 249 | Copenhagen. Teleg. cable | 35 |
| Cape Town | 309 | " Teleg. mat. | 170 |
| " Teleg. cable | 18,480 | Durban | 808 |
| Colombo | 121 | " Teleg. mat. | 337 |
| Copenhagen | 330 | East London | 59 |
| Delagoa Bay | 233 | Fremantle | 54 |
| Durban | 1,891 | Hamburg | 360 |
| " Teleg. mat. | 282 | Hong Kong | 810 |
| East London | 45 | " Teleg. mat. | 43 |
| Fremantle | 844 | Kobe | 86 |
| Hamburg | 100 | Nagasaki. Teleg. cable | 26,750 |
| Hong Kong | 251 | Ostend | 52 |
| Madras | 55 | Penang. Teleg. mat. | 287 |
| Malta | 169 | Perth. Teleg. cable | 403 |
| Melbourne | 3,916 | Port Said | 57 |
| Newcastle (N.S.W.) | 8 | Shanghai | 309 |
| Ostend | 19 | Singapore | 97 |
| Otago | 250 | " Teleg. cable | 21,000 |
| Perth. Teleg. mat. | 200 | Stockholm. Teleg. wire | 73 |
| Port Elizabeth | 15 | Sydney | 230 |
| Rio de Janeiro. Teleg mat. | 718 | Townsville. Telephones | 98 |
| Rotterdam. Teleg. mat. | 18 | Wellington | 296 |
| Shanghai | 26 | Yokohama | 96 |
| Singapore. Teleg. mat. | 122 | " Teleg. mat. | 105 |
| Stockholm. Teleg. mat. | 69 | " Teleph. cable | 3,850 |
| Sydney | 1,284 | " Teleph. mat. | 84 |
| " Teleg. mat. | 159 | | |
| Tientsin. Teleg. mat. | 238 | | |
| Wellington | 613 | | |
| Total | £33,600 | Total | £57,899 |

### Foreign Goods Transhipped.

| | |
|---|---|
| Malaga. Elec. light cable | Value £32 |
| New York. Elec. goods | 50 |
| Perth. Elec. goods | 113 |
| Total | £195 |

**Asbestos Goods.**—Messrs. Cresswell's Asbestos Company, Limited, of Wellington Mills, Bradford, send us their Nos. 1, 2, 3, and 4 catalogues. No. 1 gives some notes regarding their "Original" anti-friction steam and other packings, which are claimed to be specially economical; No. 2 is devoted to their asbestos manufactures in the way of sheeting, washers, joints, paints, and so on; No. 3 explains their Amianscal disincrustant for the removal and prevention of incrustation, and prevention of corrosion or pitting in stationary locomotive and marine boilers; and No. 4 details their improved Asbestos-Bergmehl and magnesia non-conducting coverings (fireproof for boilers). We understand that Messrs. Cresswell are continually supplying their asbestos goods for electrical purposes, as well as for engine packings, jointings, disincrustants and coverings. There are the special electrical uses of asbestos in the forms of cloth ropes, cords, twines, millboards, &c. They make large quantities of asbestos fireproof paint for electric conduits and wood casings and new unpainted work generally that is exposed to risk of firing from "flashings."

**Bankruptcy Proceedings.**—An application for an order of discharge was made some days ago at the London Bankruptcy Court on behalf of Herbert R. Killik, lithographic artist, lately carrying on business at 181, Queen Victoria Street, E.C., in partnership as Taylor & Killik. The Official Receiver reported that in October, 1897, Mr. Taylor patented an invention for electrically illuminating advertisements, known as the Reflex Advertising Medium, of which his partner was to have a half share, Mr. Taylor further agreeing to devote the greater part of his time to developing and selling the patent. Having no capital with which to develop the patent the bankrupts sold a half share of it for £500, and borrowed £1,200 on their joint promissory notes. They were unable to sell the patents, and in March, 1899, the stock and effects were distrained upon and sold by the landlord. The failure was attributed by Mr. Taylor to insufficiency of capital, to neglect of the business by his partner, and to inability to dispose of the electrical patent. On the other hand, Mr. Killik ascribed the firm's position to his partner's excessive drawings, to his partner's failure to account for certain book debts which he had collected, and to liabilities in regard to the Reflex patent. In the opinion of the Official Receiver the failure was caused mainly by the over-drawings of both bankrupts, and by the expenditure on and liabilities in connection with the electrical invention. The firm failed last May, with ranking liabilities, £2,251 6s. 1d., and assets valued at £193 3s. 5d., but which only realised £28 16s. 1d. Various offences were reported by the Official Receiver, and after hearing Mr. H. W. Patey, in support of the application, the learned Registrar upheld the report, and suspended the order of discharge for two years.

Under the failure of Archibald E. McKechnie, described as of 7, Newton Road, Bayswater, an application was made to Mr. Registrar Brougham last Friday at the London Bankruptcy Court for approval to a scheme of arrangement recently entertained by the creditors. Mr. Howell, assistant receiver, reported that the debtor went to America in 1874, whilst there he became interested in the development of various electrical patents, and for some years assisted in the formation and management of companies connected therewith. He returned to London in July, 1896, and has since lost £700 by making advances on patents. The failure is further ascribed to the debtor's liability on a promissory note accepted jointly with another person. The scheme provided for payment of a composition of 7s. 6d. in the £ on the liabilities, except upon £530 due to the debtor's two brothers who had agreed to withdraw their claims. In the opinion of the Official Receiver the arrangement was calculated to benefit the creditors. His Honour ordered the scheme to be approved and the receiving order to be rescinded.

Notice is given of release of trustee in *re* C. F. S. Pilling, electrician, of Bolton, Lancs.

**Liquidations, &c.**—Creditors of the Continental Water and Electrical Power Syndicate must send particulars of their debts or claims, &c., to Mr. H. Meredith, 95, Finsbury Pavement, E.C., liquidator, by March 25th.

The first meetings of creditors and contributories of the Madras Electric Tramways Company, are arranged for March 9th at 11 and 12 o'clock respectively, at 33, Carey Street, W.C.

**Books Received.** — "Mesures Electriques" par Eng. Vigneron and P. Letheule. Paris: Gauthier-Villars. 2 fr. 50 c.

"Fire Tests with Safes," No. 42, and "Fire Tests with Protective Coverings," No. 43. London: The British Fire Prevention Committee. 2s. 6d. each.

**Country House Lighting.** — The lighting of Hayes Place, Bromley, Kent, is being carried out by the Phodyne Electrical Company, Limited, to the specification of Mr. Morgan Williams, consulting engineer. The plant will consist of two 15-h.p. gas engine and dynamo belt-driven sets, together with a battery of 55 accumulator cells. The number of lights at present being installed amounts to 274.

**Electric Power Schemes.**—At a meeting held on Tuesday at the London Chamber of Commerce to consider what steps should be taken in view of the opposition of the municipalities to the second reading on March 1st of the various Bills for the provision on a large scale of power for manufacturing and other purposes in various industrial districts in England and Wales, the following resolutions, moved by Lord Avebury, and seconded by Mr. H. Seton Karr, M.P., were unanimously adopted:—

(*a*) That this meeting regrets the action of the representatives of municipalities and local authorities in opposing the second reading of Bills promoted by companies for the distribution of "power in bulk" for industrial and general purposes in various districts in England and Wales, and urges upon Parliament the desirability of allowing such Bills to be read a second time and referred to a committee in order that they may be examined in detail on their merits. (*b*) This meeting further urges that in view of the promise of the Government to appoint a Joint Committee to inquire into the whole question of municipal trading in competition with, and to the exclusion of, private enterprise, the consideration of all provisions in the various Bills and Provisional Orders promoted by municipalities and local bodies authorising municipal trading be deferred pending the conclusion of the said inquiry. (*c*) That a petition be presented to Parliament praying Parliament to pass the second reading of the Lancashire Electric Power Bill and other similar measures. (*d*) That a copy of these resolutions be sent to the Board of Trade and to every member of Parliament.

**Hart Accumulators.**—The Hart Accumulator Company, Limited, state that they have this week received the orders for the supply of central station batteries to be used in connection with the electric lighting schemes for the following places:—Hertford, Penarth, Durham, Lewes, Weston-super-Mare, Barnet, and Gateshead.

**Lockwood's Builders' Price Book.**—The new edition of this annual contains, as usual, an electrical section giving just that information as to electric lighting which is likely to assist builders and contractors in making rough estimates. The prices and calculations have been revised for this edition. It is interesting to learn from the preface that as regards the building trade generally, high prices are maintained for both material and labour, that iron and lead have risen to a higher value than ever before known, that workmen undoubtedly do less work for their money than they used to do, and that there is at present no prospect of any fall in prices in any direction.

**New Chemical Works.**—On Monday the construction of extensive new chemical works at Cledford Bridge, near Middlewich, was commenced. They are for the Electrolytic Alkali Company, whose present offices are at St. Helens. Orders have been given for engines and dynamos, and the total cost is estimated at £100,000.

**Presentations.** — A new "brass shop" in connection with the electric works of T. Parker, Limited, Wolverhampton, has just been completed; and for the purpose of celebrating the opening of the shop about 100 of the workpeople dined on Saturday evening at the Seven Stars Hotel, Wolverhampton. Mr. A. Preece, the foreman of the department, presided and was presented with a marble clock and a pair of equestrian bronzes by his fellow workpeople. The presentation was made by Mr. T. A. Parker.

The electric staff at Messrs. John Brown & Co., Sheffield, presented on Monday last, February 26th, a massive brass kerb and fittings to match, to the head assistant electrician, Mr. R. G. Ward, on the occasion of his marriage. The presentation was made by Mr. D. G. Jones, chief electrical engineer.

**"Robertson" Lamp Works.**—A party of students from the Institution of Electrical Engineers visited these works at Brook Green on Thursday afternoon, February 22nd, and were shown in detail the various operations connected with the manufacture of the "Robertson" lamp.

**The Rubber Industry.**—In the House of Commons last week, Mr. Weir asked the Secretary of State for the Colonies, whether he was aware that the value of rubber imported from the British Central Africa Protectorate through Chiromo amounted during the year 1898-99 to £10,233 18s., as compared with £1,044 17s. 6d. in 1897 98, showing an increase of over £9,000 in one year; and would he state whether any efforts were being made to regulate the mode of collecting rubber juice, so as to prevent destruction of the rubber vines. Mr. Brodrick, who replied, said it was so stated in the last report on the Protectorate. Regulations regarding the manufacture and sale of rubber were issued on September 1st last.

**Smoke Nuisance.** — At Westminster on Tuesday the Westminster Electric Supply Corporation were summoned by the Westminster Vestry for having furnaces constructed so as not properly to consume their own smoke. Mr. J. W. Kirk, one of the Vestry's inspectors, proved that dense black smoke for periods of 10 minutes, a quarter of an hour, and even longer, was emitted from the chimneys of the defendant company's supply station at Millbank Street, Westminster. Mr. Conway Grimshaw, assistant engineer-in-chief, said the usual type of furnace with water-tube boilers was employed. There had been some little smoke at firing-up times, because the Welsh smokeless coal could not be obtained. The County Council had a Bill before Parliament to take over the works, and pending this event any change of boilers or furnaces would mean a wasteful expenditure of thousands of pounds. Mr. Horace Smith fined the defendants £10 and two guineas costs.

**Trade Announcements.**—The "Unbreakable" Pulley and Mill Gearing Company, Limited, inform us that they have appointed Mr. Claude Taylor, of 25, Manchester Street, Oldham, as agent for Oldham and district for the sale of their "Unbreakable" pulleys, adjustable and swivel bearings, and other manufactures for the mechanical transmission of power.

Mr. W. J. R Thomas has commenced business as a consulting electrical engineer at 19, Woodstock Road, Moseley, Birmingham. We understand that for the last three years he has been electrical inspector and adviser to the Birmingham Corporation, being previously on the staff of the St. Pancras Vestry for some years in charge of mains, public lighting, sub-stations, &c.

Messrs. O'Brien & Co., have removed temporarily from 62 & 63, Minories, E C, to 3 & 4, Sparrow Corner, Minories. The stores will still be at 105, Minories, where a stock of English and American tubes, fittings, and tools is kept.

Messrs. O'Gorman & Ozzens-Hardy draw attention to change of their address, which is now 82, Victoria Street, S.W.

**Wheeler Condensing Plant.**—The contract for the supply of surface condensers for the new Stanhope line at Aldershot has been placed with the Wheeler Condensing and Engineering Company by the War Office. This firm also report that the cooling tower and condenser contract for the Charing Cross and Strand Electricity Supply Company has been placed with them, covering a plant of 3,000 H.P.; also the cooling tower and condensing plant required for the Chadwell Heath Asylum of the West Ham Corporation. The St. Helens Corporation have placed a duplicate order for a plant having a condenser with 2,000 square feet of cooling surface. The condensing set for the new electrical supply station for the Birkenhead Corporation has also been placed with this firm; and two large condensing sets for the Camps Bay and Cape Town Tramways, consisting of compound steam-driven air and circulating pumps with condensers. Among a great number of other orders received have been two sets for the Cardiff and Milford Cold Storage Company's refrigerating plant. Messrs. Bewick & Moring have placed a duplicate order for a set similar to the outfit required for the Great Fingall Mines, and the Sheepbridge Coal and Iron Company have ordered a large condensing set of 1,000 H.P. capacity for the hauling engines at their Glapwell colliery.

## ELECTRIC LIGHT AND POWER NOTES.

**Alfreton.**—The Urban District Council has resolved to appoint Mr. J. S. Barnes as electrical engineer, and to apply to the Board of Trade for a provisional order for the supply of electricity in the district.

**Asylum Lighting.**—Mr. A. A. Campbell Swinton has received instructions from the Asylum Committee of the Northumberland County Council, to prepare a specification for the electric lighting of the County Lunatic Asylum, at Morpeth.

**Belfast.**—The Electricity Committee has recommended the Borough Council to reduce the charges for electricity supply.

**Birkenhead.**—A well-written article recently appeared in the *Birkenhead News* on the subject of the electricity supply, in which a strong attack was made on the manner in which the Gas, Water, and Electrical Committee has managed the municipal electricity undertaking. Birkenhead is a town of 116,000 inhabitants, but after 3½ years' working, the consumers number only 171, and the averge price charged for supply is 5½d. We have often pointed out the folly of entrusting the supply of electricity to the care of a Gas Committee. Where the two undertakings are run in competition, the invariable rule is that both prosper; but where they are both in the hands of the same authority, in spite of certain honourable exceptions, the rule is for the electrical department to be smothered.

**Bradford.**—A Local Government Board inquiry was held last week into the application of the City Council for leave to borrow £10,000 for extensions of the electrical works, &c. The town clerk stated that there was an increasing demand for electrical energy for lighting and motive power, while the works also supplied the two electric tramways; the undertaking is now making large profits. Mr. A. H Gibbings, the electrical engineer, gave evidence as to the need of extensions, and the inquiry closed without opposition.

**Bristol.**—A few weeks ago reference was made to a controversy which had been occasioned between Mr. Henry Williams, the architect of the existing electric lighting station at Bristol, and the Electrical Committee, owing to the decision of that committee to erect their new station at Avonbank, St. Philips, without his professional assistance for the above ground work. The subject came before the Council in a report which recommended the appointment of Mr. K. O. Hale as architectural and engineering draughtsman. Alderman Pearson explained that the committee (having advertised in the ELECTRICAL REVIEW) had selected Mr. Hale from a number of applicants and proposed to pay him £200, rising to £250 a year. In moving the adoption of the report, Alderman Pearson intimated that the new electrical station would be planned by the electrical engineer, and the new officer would be one of his staff. He refrained from commenting on a circular letter sent round by Mr. Henry Williams to the councillors, but subsequent speakers alluded to it frequently, and while some contended that Mr. Williams had been actually appointed as architect of the new electric station, others argued that his appointment was limited to extensions at the existing station, his services at the new site being confined to purchasing the property for the committee and putting in the foundations. An amendment was proposed referring back the proposed appointment, and calling upon the Electrical Committee to employ an architect. Alderman Pearson, in replying, feelingly resented the charges made, and warned the County Council that if the Committee was to be fettered by such an instruction, he should resign the chairmanship. As a matter of fact, the new building was not one requiring an architect. It would not front a road; it would differ from the existing station, and the problems it raised were such that if there was any doubt about the electrical engineer's plans, the proper course would be to submit them to a consulting engineer. Sir William Preece was consulted when the existing station was designed, and that would be the proper course to adopt in this case if a consulting engineer were required. An outside architect could not prepare plans unless the electrical engineer gave him the information about the positions of boilers and machinery. The Council, however, passed the amendment, and Alderman Pearson at once notified his resignation of the chairmanship of the Electrical Committee. Bravo, Mr. Pearson!

**Cardiff.**—The Chamber of Commerce has unanimously resolved to support the South Wales Electrical Power Distribution Bill, the provisions of which are regarded as of great commercial value.

**Chester.**—The Town Council has approved of the recommendations of the Lighting Committee, to the effect that a loan of £35,000 be raised for extensions of the electric lighting works and mains.

**Coventry.**—The statement of the Electric Light Committee for the quarter ending December 31st, shows that electricity supplied during the quarter amounted to 86,295 units as compared with 45,423 units for the corresponding quarter in the previous year. The consumers increased from 128 to 198, and the rentals from £1,042 8s. 6d. to £1,340 11s 2d.

**Friern Barnet.**—The District Council has resolved to petition against the Bill of the North Metropolitan Electric Power Supply Company.

**Guildford.**—Considerable trouble has come to the Guildford Electricity Supply Company on account of the damage sustained at the works by the floods. In one building are situated three 40-H.P. generating sets; two of these were running on Friday, 16th ult., but as the water continued to rise their working was stopped, and the water was so deep that the field magnet coils were just under water. In the building adjoining are two 100-H.P. machines, which stand considerably higher than the machines referred to, and on the first-mentioned being stopped one of the latter was set to work. The water, however, about half-past three in the afternoon, reached such a height that sufficient draught could not be obtained to keep steam up, and accordingly this had to be shut down. As a result, there was no electric light in the town between Friday afternoon and Saturday

morning, when some of the machinery was started again. Some of the machines were still not able to run on Thursday last week, and it must be a matter of time before the damage can be fully ascertained. An explosion took place on Saturday afternoon in a connecting box through the water breaking down the insulation of the cables. The damage was slight.

**Huddersfield.**—The revenue account of the electricity undertaking for the year 1899, shows a surplus of £1,828 16s.; while the number of lamps connected has only increased from 70,178 to 70,802, the units supplied during January last amounted to 138,883, as compared with 101,583 for the corresponding period last year.

**Kandy.**—The electric lighting installation of the Colombo Gas and Water Company was successfully inaugurated on the 29th ult. Mr. J. E. Addyman is the resident engineer.

**Knutsford.**—The Electricity Committee has now received the report on the lighting of the town, which Messrs. Lacey, Clirehugh & Sillar were instructed to prepare.

**London.**—Court of Common Council.—At the meeting on Tuesday last week the Streets Committee reported on certain letters received from the Charing Cross and Strand Electricity Supply Corporation with regard to the financial arrangements in connection with the City of London Electric Lighting Order 1899. The report states that the company proposes to vest the order in a new company, in which event arrangements will be made to carry out the work simultaneously with certain works contemplated by the Post Office authorities. The Committee recommended that no objection be offered to the proposal, provided that the sanction of the Board of Trade be obtained, that it should in no way prejudice the Corporation or consumers, and that the expenses of formation and carrying on of the new company should form no part of the purchase money in the event of the Corporation deciding to acquire the undertaking. A letter from the company was read stating that the expenses in question would be insignificant. After discussion, the Court rejected the report. Further reports relating to the acquisition of a site for a generating station at Bow and to the laying of cables in the western district of the City were approved. A report relative to the proposed alteration of the standard pressure of supply from 100 to 200 volts by the City of London Electric Lighting Company was also approved.

Rotherhithe.—The Vestry has offered the electricity supply company half the amount charged for electrical energy, under protest, leaving the remainder to be sued for by the company; this action is intended as a protest against the alleged irregularity of the supply.

**Nuneaton.**—A Local Government Board inquiry is to be held on March 8th respecting the proposal to borrow £16,000 for electric lighting purposes.

**River Shannon.**—By the proposed scheme of the Shannon Water and Electric Power Company, it is proposed to take the water from the Shannon at a point near the entrance of the Board of Works Canal at Errina, whence an aqueduct will conduct the water to a point near Clonlara, where it is proposed to build a large power house, in which all the necessary turbines and electric machinery will be located. At this point a fall of 38 to 40 feet can be obtained. The waste water from the turbines will be conducted thence by a new cut having its outlet close to Plassy Bridge. No engineering difficulty is presented in this portion of the work; a good deal of earthwork will have to be removed, affording a large amount of local employment. The execution of this portion of the work will occupy, it is anticipated, two years. The electrical current will be distributed from the power station to Limerick, there to be used for industrial purposes. In order to provide compensation water to that portion of the river between the inlet and outlet, it is proposed to utilise the great storage capacity of Lough Derg by making arrangements, with the consent of the Board of Works, and subject to all proper safeguards for preserving the navigation, for the lowering of the lake a few feet, by means of the existing sluices. The lake has an area of 30,000 acres, and an average depth of about 20 feet, but it is only proposed to lower it about 3 feet, as a maximum, which it is found will only necessitate a moderate amount of dredging at the quays and in the channel to preserve the navigation as fully as it is at present. To meet this lowering, it is necessary to deepen the Board of Works Canal from the Pier Head at Killaloe to Moys Lock to a similar depth of 3 feet. The Bill is pending in Parliament, and full evidence as to the necessary details will be presented to the Committee; all reasonable and proper clauses for the protection of the navigation and fisheries will be inserted in the Bill. During eight or nine months of the year the discharge from the enormous drainage area of 4,500 square miles of the Shannon would suffice to generate 20,000 H.P., and it is only for a very short period of the year that the lake would require to be drawn upon for the compensation water. The carrying out of this work will involve an expenditure of some £200,000 in the district. In view of the immense development of manufacturing industry in the United States and Canada and on the Continent, it is felt that Ireland, possessing water-power, but being deficient in coal supply, is eminently suited for a work of this character, especially in the present case, where the power can be utilised in a large city which possesses excellent facilities for shipment. Almost every class of work from the sewing machine to the trip hammer can be operated by means of electrical power; and the city, possessing facilities for retaining cheap labour, should speedily advance in the development of its manufacturing industries.

The members of the Urban District Council of Ennis have unanimously passed a resolution approving of the project.

The Portumna District Council, recognising the importance of establishing industries in the district, has decided to take no action hostile to the project.

**Southampton.**—A Local Government Board inquiry was to be held on Wednesday into the application of the Corporation for leave to borrow £55,000 for electric lighting purposes.

**Swansea.**—Tenders are to be invited until March 12th for electric light cables. A proposed agreement with the National Electric Free Wiring Company has been circulated among councillors before a final decision is arrived at.

**Yeadon.**—The District Council has decided to visit a number of places similar in size and population to Yeadon, where the electric light is in operation, and to ascertain if the Leeds Corporation, which has been asked to carry out the proposed scheme of tramways, will supply Yeadon with electricity for lighting purposes, either in bulk or retail. In his report, Mr. Enright propounds a scheme entailing a capital expenditure of £12,600 for 4,500 8-c.p. lights, with an estimated annual expenditure of £1,540, and an estimated income of £2,035.

**York.**—The Corporation electricity works was formally opened on Monday last. The generating plant, the specifications for which were drawn up by Prof. Kennedy, consists of two Lancashire boilers, four steam dynamos rated at 380 I.H.P. in all, and a storage battery. At present about 4,000 8-c.p. lamps have been connected, and a large number are awaiting the extensions of the mains. About 3,000 lamps are to be installed in the Municipal Buildings alone. Messrs. Crompton & Co., Limited, supplied the machinery, and Messrs. Callender's Construction and Cable Company, the mains.

## ELECTRIC TRACTION NOTES.

**Dublin and Lucan.**—The equipment of the above line for electric traction has just been completed, and it was thought probable that the new system would be open for traffic by March 1st, after the customary Board of Trade inspection. A greatly improved service between Dublin and Lucan will then be established, and the company have provided entirely new rolling stock in connection with their equipment.

**Liverpool.**—The Liverpool Overhead Railway Bill was last week sent by the examiner for second reading in the House of Lords.

**Middlesex Light Railways.**—The Middlesex County Council last week approved the terms of the proposed agreement with the Metropolitan Tramways and Omnibus Company (and with the North Metropolitan Tramways Company), in regard to the County of Middlesex Light Railways Joint Order promoted by the County Council and the company. The agreement provides that the County Council may, within six months from the passing of the order, require the company to sell its interest to the Council at the cost price of the order, and in this case the Council will provide all the land for the purpose of the undertaking and construct the lines and works, whilst the company are to erect the generating stations, fixed machinery, engines, carriages and rolling stock. It is stipulated that the term of the lease shall be 25 years, and the company pays "rents" on all moneys expended by the Council in connection with the promotion and construction of the lines. The rents in this respect are to be for one-third of the term current at the date of the lease a fixed half-yearly rent equal to 2 per cent. (being 4 per cent. per annum), for another third, 2½ per cent. for the six months, and for the remaining third 2½ per cent., or at the rate of 5 per cent. per annum. This clause also provides for the payment of a further half-yearly rent equal to 45 per cent. of the net revenue of the company. On the expiration of the lease the company will be under the obligation to sell to the Council the buildings and machinery and plant at a sum to be agreed upon, or as may be settled by an arbitrator appointed by the Board of Trade.

**Newport.**—A discussion on the proposal to adopt electric traction for Newport tramways took place at a meeting of the Newport Junior Liberal Association on Wednesday evening, when the subject for discussion was "Municipal Projects." A number of town councillors attended and aired their views. Councillor Llewellyn, chairman of the Electricity Committee, said he believed that the conversion of the tramways from horse to electric traction would result in a profit of £10,000 to £15,000 per year. Mr. C. Jones asked if the Council would work the tramways themselves, or let them to a company when they had adopted electric traction. Councillor Llewellyn replied that this had not been decided. Councillor Gower hoped the Corporation would construct the new tramways themselves by direct labour. Councillor Brown said that it would be proposed at the next Council meeting that they should proceed with the construction of the Corporation Road line. The Council were unanimous upon the question of adopting electric traction; the only difference was upon the question of the site for the power station. Councillor Williams was in favour of the Corporation working the trams, and hoped they would do nothing in a half-hearted manner, but erect power station, car sheds, and work sheds on the Corporation Road site.

**St. Helens.**—Two electric cars on the Prescot section of the St. Helens tramways came into collision on Saturday. One was knocked off the line and the traffic was greatly interfered with. The accident is stated to have been caused by a driver running past the loop.

**Southampton.**—There is to be no further litigation respecting the transfer of the tramways from the Southampton Tramways Company to the Corporation. The directors of the former, after mature consideration, have arrived at the conclusion that the chances of a successful appeal to the House of Lords against the judgment of the Queen's Bench Division, and confirmed by the Court of Appeal, is too doubtful to justify the additional expense and delay of adopting this course. They have therefore issued a circular suggesting that no further proceedings be taken, and that the company be wound up forthwith with the view of making an early distribution among the shareholders of the balance of assets left after paying off the debentures and preference shares. The sum specified in the award confirmed by the Courts was £51,505.

**Swansea.**—Mr. T. Grenville Lewis has been appointed South Wales superintendent of the British Electric Traction Company in the place of Mr. D. F. Sugrue, J.P., who is leaving Swansea for London to take up a more important appointment in connection with the same company.

## TELEGRAPH AND TELEPHONE NOTES.

**Cardiff Telephones.**—On Monday the Cardiff Parliamentary Committee had before it the question of municipal telephones. When the Act was passed providing for licences being granted to municipal authorities, the Cardiff Town Council promptly made application. Mr. Hanbury (Financial Secretary to the Treasury) pointed out that in Cardiff the Post Office telephone system was in competition with the National Telephone Company. He desired to know whether the Corporation would take over the Post Office system on a lease covering the period which still remains to the National Company in their licence—about 11 years. The town clerk was then requested to ascertain upon what terms the lease would be granted, and what were the annual receipts of the Post Office in Cardiff and the district from telephone messages. Letters had now been received from the Postmaster-General and Mr. J. M. Maclean, M.P. In both communications the Corporation are asked for a reply to an offer which was made to them as far back as October.

**Glasgow Municipal Telephones.**—A Glasgow paper says that Mr. A. R. Bennett, the telephone engineer to the Corporation, has submitted a report regarding the proposed municipal telephone exchange. He is of opinion that, in the first instance, a complete exchange for 5,250 metallic circuit lines—viz., 5,000 subscribers within the city and suburbs, 200 in outlying places in the telephone area, together with 50 public telephone offices—should be undertaken. This number of completed lines exceeds by 50 that provided for in his 1897 estimate. At the same time provision should be made as regards floor space in the switch rooms, plans of the switchboards, size of distributing poles, and number of conduits in the vicinity of the switch rooms (so as to avoid re-opening of streets) for another 5,250 lines, making a total of 10,500 lines, for which the ground work would be laid. As regards available floor space and its possible future extension and accessibility of premises for conduit purposes, a probable further expansion to 20,000 lines should be borne in mind. He estimates the total expenditure at £121,000—namely, 5,250 completed lines, £100,000; and 5,250 partially completed lines, £21,000. The Telephone Service Committee recommend that the Corporation should remit to them to secure premises for switch rooms, to proceed with the organisation of a telephone department, and the establishment of a municipal telephone system on the lines indicated in the report; and also to apply for the consent of the Secretary for Scotland to the Corporation borrowing £120,000 for telephone purposes in terms of the Telegraphs Act, 1899.

**The Pacific Cable.**—Reuter's Agency is informed that the Agent-General for New Zealand, under instructions from his Government, has handed in a letter to the Colonial Office expressing very strong objection against the concessions asked for by the Eastern Telegraph Company, on the ground that they would militate against the success of the Pacific cable, to the construction of which the New Zealand Government holds itself fully committed.

**Strike.**—About 150 labourers and wiremen employed by the National Telephone Company in Leeds and Hull came out on strike last week for an advance of wages. The result of the strike is that the work of repairing wires, that have been rendered useless by the recent storm, comes to a standstill.

**Telegraph Subsidies.**—In the House of Commons on Tuesday Sir E. Sassoon asked the Secretary to the Treasury if he would state the amount of subsidies paid during 1898-99 to the Eastern Telegraph Company by the Imperial and Colonial Governments. Mr. Hanbury, replying, said: I presume that the hon. member refers not to the Eastern Telegraph Company alone but to the group of which it forms the centre. From Imperial funds £19,000 was paid in 1898-99 to the African Direct Telegraph Company and £63,000 to the Eastern and South African Telegraph Company, but £18,000 was repaid to the Exchequer in respect of the latter subsidy (£10,000 from India, £7,000 from Mauritius, and £1,000 from Seychelles), and £5,000 in respect of the former from various West African colonies. From colonial funds £15,000 was paid to the Eastern and South African Telegraph Company by the Cape Government, and £5,000 was paid to the same company by the Natal Government; £32,400 was paid by Australasian Governments to the Eastern Extension Telegraph Company in respect of the duplicate cable subsidy (which finally ceased in October, 1899), and £4,200 in respect of the Tasmanian cable subsidy, besides a payment of £2,632 on a traffic guarantee for New Zealand cables which can hardly be reckoned as a subsidy. I understand, also, that the Government of the Straits Settlements paid £400 to the Eastern Extension Company in respect of a telegraph to Malacca.

**Telegraph Breakdowns.**—In the House of Commons last week, in reply to Sir J. Leng and Mr. Caldwell, who asked questions in regard to the interruption of telegraphic and telephonic communication between London and the north of England in consequence of the recent storm, Mr. Hanbury said:—

The period of interruption has varied considerably in the case of different towns, and it is impossible at present to give details in regard to the number and mileage of the wires blown down or the number of messages delayed. The storms have been of almost unexampled extent and severity. Until now there had not been a general interruption of telegraphic communication with Scotland since 1886. The want of any form of insulated wire which could be provided at a reasonable cost, and would give even moderately satisfactory results from a telegraph point of view, prevented the Postmaster-General for many years from laying down long underground lines; but he took steps to minimise as much as possible the risk of total interruption of the overground lines by erecting them along distinct and separate routes and by providing reserve wires. On the introduction of a new form of insulated wire at a moderate price which gave promise of satisfactory results in telegraphy, he had it tried, and then proceeded to lay down a line of no less than 76 wires from London to Birmingham. This line, which has taken about three years to construct, is now on the point of completion. It passes underground through that part of the country which is subject to the most destructive gales, and it will give an increased measure of stability to the whole telegraph system. Notwithstanding the advantages which the new form of insulated wire possesses over the old, it is not free from defects, and unforeseen electric difficulties have presented themselves, which his engineers and electricians are now endeavouring to overcome. The suggestion that a submarine cable should be laid in the North Sea to maintain telegraphic communication between London and Scotland cannot be entertained.

**Telegraphic Interruptions and Repairs:—**

| Cables. | Down. | Repaired. |
|---|---|---|
| West Indies:— | | |
| Jamaica-Colon ... ... ... | June 30, 1899 ... | ... |
| Trinidad-Demerara (1891 duplicate) ... ... ... ... | Oct. 23, 1899 ... | ... |
| New York-Hayti ... ... ... | Feb. 26, 1900 ... | ... |
| Cayenne-Pinheiro ... ... ... | Oct. 11, 1899 ... | ... |
| Cayenne-Paramaribo ... ... | Feb. 16, 1900 ... | ... |
| Ceara-Maraham ... ... ... | Feb. 20, 1900 ... | ... |
| Latakia-Cyprus ... ... ... | June 20, 1899 ... | ... |
| Majunga-Tananarive ... ... | Feb. 9, 1900 | Feb. 22, 1900 |
| Tarifa-Tangier ... ... ... | Jan. 2, 1900 ... | ... |
| **Landlines.** | | |
| West Indies:— | | |
| Communication with Port de Paix (Haiti) ... ... ... ... | Feb. 20, 1900 | Feb. 21, 1900 |
| Communication with Port de Paix (Haiti) ... ... ... ... | Feb. 26, 1900 ... | ... |
| South African:— | | |
| Communication with Mafeking and beyond ... ... ... | Oct. 13, 1899 ... | ... |
| Communication with all offices beyond Orange River ... ... | Oct. 18, 1899 ... | ... |
| Communication with north of Mooi River (Natal) ... ... | Oct. 22, 1899 ... | ... |
| Communication with Colombia ... | Oct. 23, 1899 ... | ... |
| Communication with all towns of United States of Colombia beyond Buenaventura ... ... ... | Jan. 22, 1900 ... | ... |
| Communication with Rome-Pera beyond Vallona ... ... ... | Feb. 15, 1900 ... | ... |
| Communication interrupted "*vid* Hanekine" on Persian Territory... | Feb. 24, 1900 ... | ... |

**The Australia-Cape Cable Scheme.**—A Reuter despatch from Melbourne, dated February 28th, says that the details have now been arranged of an agreement between the Governments of New South Wales, Victoria, South Australia, Tasmania, and Western Australia, and the Eastern Extension Telegraph Company in connection with the projected cable between Australia and the Cape.

**The Uganda Railway Telegraphs.**—A Reuter despatch dated Mombasa, Tuesday, says that the Uganda railway telegraph line reached the Nile at Ripon Falls on February 18th, and was carried across the river in two spans on the 19th, thus establishing telegraphic communication between London and the sources of the Nile.

**Wireless Telegraphy.**—A statement explanatory of the 1900-1901 Navy Estimates contains, according to the *Times*, some notes on the above subject. It is stated that the Marconi system of wireless telegraphy was tried in the Naval Manœuvres of 1899, and proved very successful so long as only one ship was signalling. Signals were taken in successfully at a distance of 60 miles. Negotiations have been carried on between Her Majesty's Government and the Marconi Company, but the question of terms has not yet been settled. In the meanwhile the Admiralty are endeavouring to procure, for further and more extended trials, some more installations of wireless telegraphy, both from the Marconi Company and from other sources.

Contracts have been made for connecting all the islands of the Hawaiian Group by the Marconi wireless telegraph system. Mr. Marconi has, according to a Sydney newspaper correspondent, made a personal study of the geography of the islands, with a view of ascertaining whether his system could be used, and it is claimed that perfect communication between all the islands of Hawaii can be established at small expense, as well as facilities for speaking and communicating with vessels some time before they get into the harbour of Honolulu.

## CONTRACTS OPEN AND CLOSED.

### OPEN.

**Dartford.**—March 27th. The Urban District Council is inviting tenders for the supply of Lancashire boilers, pipework, surface condenser, two high speed steam dynamos and motor boosters, batteries, switchboard, overhead traveller, mains, conduits and roadwork, arc lamps and posts, and station lighting. See "Official Notices" to-day.

**Durban (Natal).**—April 2nd. The Corporation is inviting tenders for 1,900 tons of steel girder rails, 64 tons of fishplates (bolts, bonds, &c.), 407 loads Australian hardwood stringers, &c, also the laying of same for 14·36 miles of single track, and bonding 2·96 miles of equivalent existing single track, the Corporation laying concrete foundations and making up roadway. See "Official Notices" February 9th.

**Edinburgh.**—March 5th. The Corporation wants tenders for the extension of the electric lighting at Shrubhill tramway power station. See "Official Notices" February 23rd.

**Farnworth.**—March 7th. The Urban District Council invites tenders for Lancashire boilers, economisers and other steam plant, three 120-KW. steam dynames, lighting and traction switchboards, accumulators, underground cables, travelling crane, and re-cooler tower. See "Official Notices" February 16th.

**France.**—March 8th. The French Post and Telegraph authorities in Paris are inviting tenders until March 8th for the supply of 229 kilometres of gutta-percha insulated electric cable in six lots. Particulars may be obtained from, and tenders are to be sent to, Le Sous-Secretariat Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris.

**Islington.**—March 14th. The Vestry wants tenders for a year's supply of electrical stores. See "Official Notices" to-day.

**Lancaster.**—March 22nd. Tenders are wanted for three Lancashire boilers, superheaters, economiser; three 175-B.H.P. steam dynamos, booster, switchboard, pumps, cranes, &c.; accumulators; feeder mains (solid system); and wiring of buildings, all for electric lighting purposes at the Rainhill County Asylum. Particulars will be found among our "Official Notices" February 23rd.

**Leeds.**—March 8th. The Corporation invites tenders for wiring for the electric lighting of the crypt of the Town Hall. Specification and form on application at the Electric Lighting Department, 1, Whitehall Road, Leeds.

**Leeds.**—March 21st. The Tramways Committee wants tenders for one, two, or three steam dynamos. See "Official Notices" February 23rd.

**Newcastle-on-Tyne.**—March 2nd. The Tramways Committee wants tenders for 130 car bodies, trucks, and electrical equipment for same. See "Official Notices" February 2nd.

**South Shields.**—March 12th. The Corporation wants tenders for high and low tension cables and ducts. See "Official Notices" February 23rd.

**Spain.**—March 12th. The municipal authorities of Almaden (Ciudad Real province) are inviting tenders until March 12th for the concession for the electric lighting of the town during a period of 10 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Almaden (Ciudad Real).

**Sunderland.**—March 2nd. The Corporation wants tenders for the supply of steam, exhaust, feed and other pipes, and two steam-driven induced draught fans and accessories. See "Official Notices" February 9th.

**Swansea.**—March 12th. The Corporation invites tenders for insulated electric mains, conduits, junction boxes, &c., for electricity supply. See "Official Notices" to-day.

**Wigan.**—March 3rd. The Corporation wants tenders for steam piping, feed pumps, circulating pumps, feed water heaters, piping, &c., for electricity works. See "Official Notices" Feb. 23rd.

### CLOSED.

**France.**—The French Post and Telegraph authorities in Paris lately called for tenders for the supply of 585 kilometres of paper insulated electric cable in 12 lots. Two of the lots were not given out, but 10 were placed as follows:—Messrs. G. Aborlard and Co., Paris, five lots; M. A. Grammont, of Pont-de-Churey (Isère), one lot; and La Société des Telephones, of Paris, four lots.

**Germany.**—No less than 18 firms submitted tenders for the supply of nine 3-ton electrical cranes for the State River authorities at Emden, the lowest being that of the Gutmann Maschinenfabrik Gesellschaft, of Ottensen, Hamburg, which quoted £10,923.

**Glasgow.**—The Corporation Tramway Committee on Tuesday fixed several contracts for equipping 200 electric cars. The Westinghouse Company and Messrs. Dick, Kerr & Co., Kilmarnock, each secured a contract to provide 100 motors and controllers. The total amount involved is between £60,000 and £65,000.

**Hastings.**—We are indebted to Mr. Andrews, the Corporation electrical engineer, for the following list of tenders received by the Corporation in response to their recent advertisements for transformers and sub-station switch gear. Tenders for the supply, delivery, and maintenance of 12 20-KW. transformers:—

| | |
|---|---|
| The Electric Construction Company (accepted tender) | £588 |
| Messrs. Siemens Bros. & Co. | 612 |
| The British Transformer Manufacturing Company | 678 |
| Messrs. Burnand & Co. | 680 |
| " Fowler & Co. | 684 |
| The Gilbert Arc Lamp Company | 696 |
| The British Thomson-Houston Company | 780 |
| The Brush Electrical Engineering Company | 890 |
| Messrs. Ferranti, Limited | 921 |

Tenders for the supply and erection of high tension and low tension alternate current switch gear for eight sub-stations:—

| | £ s. d. |
|---|---|
| Messrs. Cowans, Limited (accepted tender) | 1,548 16 0 |
| " Siemens Bros. & Co. | 1,759 0 0 |
| The Brush Electrical Engineering Company | 1,906 0 0 |
| Messrs. Fowler & Co. (for bus bars and fuses only) | 343 0 0 |

**Hull.**—The *Contract Journal* gives the following list of tenders received by the Electric Lighting Committee for the supply and erection of the following apparatus for their electric lighting works—viz., 30 cast-iron street section pillars, each containing eight switch fuses, &c.:—

| | |
|---|---|
| R. W. Blackwell, London* | £691 17 6 |
| Edwards's Electrical Company, London | 597 13 6 |
| Laing, Wharton, & Down, London | 855 0 0 |
| J. Fowler & Co., Leeds | 862 10 0 |
| Macartney, McElroy & Co., London | 898 0 0 |
| Electric Construction Corporation, Wolverhampton | 900 0 0 |
| British Insulated Wire Company, Prescot | 966 0 0 |
| Callender's Cable and Construction Company, London | 1,200 0 0 |
| W. T. Glover & Co., Salford | 1,410 0 0 |
| General Electric Company, London | 1,950 0 0 |
| Siemens Bros. & Co., Woolwich | 3,180 0 0 |

* Recommended for acceptance.

The Corporation Works Committee last Friday received a report from the Tramways Sub-Committee respecting the tenders for supplying 10 electric cars and 25 equipments. The three lowest were:—The British Thomson-Houston Company, Limited, £14,568; Messrs. Macartney, McElroy & Co., Limited, £14,575; and the British Westinghouse Electric Company, Limited, £14,813. There was a condition attached to the lowest tender, two objections being made to clauses in the specification. It was resolved, therefore, that the tender be accepted or such other tender as the sub-committee may think desirable in the event of a satisfactory arrangement not being arrived at.

At last week's meeting of the Electric Lighting Committee the sub-committee's minutes contained a recommendation upon a letter received from Earle's Shipbuilding and Engineering Company. For the additional sum of £600 the firm offered to fix a new patent brush adjustment on the two 480-KW. dynamos recently ordered. It was contended that the improvement would obviate all sparking, and tend to lengthen the life of the machines. The decision not to entertain the application was confirmed by the full committee. It was decided to accept the tender of Messrs. R. W. Blackwell & Co., Limited, at £691 17s. 6d. for switch boxes.

**Newcastle.**—The Newcastle and District Electric Lighting Company, Limited, have placed an order with Messrs. C. A. Parsons & Co., Heaton Works, Newcastle-on-Tyne, for two 1,000-KW. turbo-generators, each plant consisting of one steam turbine, coupled to two continuous current dynamos in tandem, and each dynamo to give an output of 500 KW. at 500 volts.

**Stockport.**—The tender of Messrs. Heap & Worthington, Manchester, has been accepted for electric wiring and fittings at the infirmary.

## FORTHCOMING EVENTS.

Friday, March 2nd.—At 8 p.m. Institution of Junior Engineers, at the Westminster Palace Hotel. Paper on "Electrolytic Zinc as a Protective Metallic Coating for Iron and Steel," by Mr. William Paddon, of Wrexham, member.

Special meeting of the Physical Society, in the Physical Laboratory of University College, Gower Street, by the kind invitation of Prof. Callendar. Agenda:—(1) "The Relative Rates of Effusion of Argon, Helium, and some other Gases," by Dr. F. G. Donnan; (2) "On the Distillation of Liquid Air and the Composition of the Gaseous and Liquid Phases," by Mr. E. C. C. Baly; (3) "The Reversibility of Galvanic Cells," by Mr. T. S. Moore; (4) "On the Damping of Galvanometer Needles," by Mr. M. Solomon.

Saturday, March 3rd.—At 3 o'clock. Royal Institution. Lord Rayleigh delivers the first of a course of six lectures on "Polarised Light."

At 2.30 p.m.—Institution of Electrical Engineers. Students' visit to Waterloo and City Railway.

At 3 p.m.—Institution of Junior Engineers. Visit to Messrs. Maudslay, Sons & Fields, Belleville Boiler Works, East Greenwich.

Electrical Engineers Volunteers' send-off dinner (see "Notes" columns this week).

Tuesday, March 6th.—At 8 p.m. Institution of Civil Engineers. Paper on "Corrosion of Marine Boilers," by John Dewrance, M.Inst.C.E.

Thursday, March 8th.—Mr. A. A. Campbell Swinton will give a lecture, illustrated by experiments, at the Camera Club, on "Steam Turbines, Land and Marine."

At 8 p.m.—The Institution of Electrical Engineers. "On the Applications of Electricity in Medical and Surgical Practice," by Dr. H. Lewis Jones, M.D.

Friday, March 9th.—At 8 p.m. Institution of Civil Engineers, Students' paper on "The Distribution of Stress in the Walls of a Thick Cylinder," by John Duncan, B Sc. (Victoria), Stud.Inst.C.E., W. A. Wales, and G. J. Day.

Saturday, March 10th.—The Institution of Junior Engineers. Conversazione at the Westminster Palace Hotel. Reception at 7 p.m. by the president, the Hon. Charles A. Parsons, F.R.S., and Mrs. Parsons, the chairman, Mr. Basil H. Joy and Miss Joy.

At 11 a.m.—Institution of Electrical Engineers, Students' Section. Visit to the works of the Langdon-Davies Electric Motor Company, Limited, 101, Southwark Street, S.E.

Tuesday, March 20th.—At 4.30 p.m. Society of Arts (Foreign and Colonial Section). Sir Edward A. Sassoon, Bart., M.P., "Imperial Telegraph Communication."

Wednesday, March 21st.—At 7 p.m. Institution of Civil Engineers. Annual Dinner, Merchant Taylor's Hall, Threadneedle Street.

## HOMES FOR DISCHARGED SOLDIERS.

### The Building Trades' Gift.

*Electrical Section.*

Contributions in kind towards the electrical equipment of the six homes, for which the detailed specifications were given in our issue of February 2nd, will be gratefully acknowledged by the honorary steward, Mr. Max Byng, of 69, Queen Victoria Street, E.C.; while the honorary treasurers, Messrs. H. Alabaster, Gatehouse & Co., of 4, Ludgate Hill, E.C., will be glad to receive cheques in aid of the gift.

We welcome the new additions to the list, and hope to see many more contributions to this most worthy object.

List of Donations to Date.

| | | | |
|---|---|---|---|
| The Electrical Review ... ... ... ... ... | £26 | 5 | 0 |
| Hooper's Telegraph and India-Rubber Works, Limited, Lombard Street ... ... ... ... ... ... | 10 | 10 | 0 |
| Messrs. E. L. Berry, Harrison & Co., electric light contractors, Whitcomb Street ... ... ... ... | 5 | 5 | 0 |

Messrs. W. J. Furse & Co., Nottingham—Fittings and labour to fit three homes with lightning conductors.

The Newton Electric Engineering Company, Taunton—One 12½-kw. dynamo.

Messrs. Rashleigh, Phipps & Co., Oxford Street, electric contractors—Labour for wiring one home.

Messrs. T. Clarke & Co., Sloane Square, electric contractors—Labour for wiring two homes.

Alley & McLellan, Glasgow—Two 50-h.p. engines at half cost price.

Mr. G Braulik, Upper Thames Street—Electric light fittings and switches.

The General Electric Company, Limited, Queen Victoria Street—Switchboards, cut-outs, ceiling roses, and switches.

Edison & Swan United Electric Light Company, Limited, Queen Street—Lamps and lampholders for the six homes.

Worthington Pumping Engine Company, Limited, Queen Victoria Street—The feed-water pumps required.

The International Electric Company, Limited, Red Cross Street—Electrical fittings.

Messrs. Johnson & Phillips, Charlton—Three coils of wire.

## NOTES.

**Electricity Works Lists.**—With our last week's issue we published our list of alternating current electric lighting stations in the United Kingdom. This week our readers will find our sheet of continuous current stations, this completing the statistics. The number of alternating works for which returns appear is 79; low pressure continuous current, 89; and high pressure continuous, 12—total, 180. It will be observed, however, that some of the works really belong to both sheets, as alternating and continuous currents are generated there.

**Railway Passenger Communication.**—The *Times* quotes from a Parliamentary paper just issued on this subject. A circular letter was sent to all the railway companies of the United Kingdom from the Board of Trade, in which it was stated that the Parliamentary Committee in 1898 unhesitatingly condemned as inefficient the outside cord system of communication, and did not regard as satisfactory methods of communication by pulling a cord or wire passing inside the carriages. They, however, held that the principal electrical systems and the method of communication by means of a partial application of the brake may be taken as efficient. The letter continued:—

> The views expressed by the Committee as to the inefficiency of the outside cord communication are fully shared by the Board of Trade, who have for years refused to approve it.
>
> The Committee recommend that the law should be extended so as to require the provision of means of communication on all passenger trains, irrespective of the distance run without a stop.
>
> The Board of Trade attach great importance to the conclusions of the Committee, and they have no doubt that those railway companies by whom the cord system is still used will at once take steps to substitute for it a proper means of communication, and that the companies as a whole will extend the provision of such a means to all passenger trains without waiting for an alteration of the law.
>
> The Board will be glad to be favoured with the observations of the directors of your company on the subject, indicating the steps which they propose to take.

In regard to the replies from the different companies, three letters from the general manager of the Great Western Company are given, the last of the series being dated the 3rd ult. They show that many of the company's trains are composed of corridor carriages already equipped with electrical means of communication, but the company have decided to adopt the brake system. The last letter from the general manager of the Great Eastern Railway Company is also of recent date—January 13th. It shows that the company have been making trial of an electrical system of communication and also of the brake system. The London and North-Western, the Great Northern, the London and South-Western, the North-Eastern, the Midland, and the North London Companies all state that they will adopt the brake system of communication. The Great Central say they have for many years employed an efficient means of communication (the brake system), which has received the approval of the Board of Trade; the London, Brighton, and South Coast Company have had in use for many years an electrical system of communication which, in their opinion, cannot be improved upon; and the South-Eastern and Chatham Companies reply that they have had in use for many years an electrical system approved by the Board of Trade, and they do not contemplate any change for the present, but will carefully watch what is being done on other lines.

**Parliament and the Electric Power Schemes.**—With reference to our quotation from the *Times* with reference to the electric power Bills and Mr. Ritchie's speech last year, Mr. Campbell Swinton writes to the *Times*, saying that Mr. Ritchie supported the second reading of the General Power Distributing Company's Bill, and, he understands, voted in its favour. Mr. Swinton continues:—

> The powers sought by the Tyneside, Lancashire, and Durham Bills now before Parliament are materially different from those asked for in the Bill that was thrown out last year, and they do not interfere to anything like the same extent with the privileges claimed by the municipalities. The three Bills mentioned above, moreover, stand on somewhat a different footing to the South Wales Bill, which goes much further than they do. All the four Bills are meeting with a strenuous opposition on the part of the Association of Municipal Corporations, which is exerting all its influence on members of Parliament to obtain the defeat of the Bills on second reading; on the other hand, the Bills have the strong support of all the leading manufacturers in the important districts they concern on the ground that these Bills will be most beneficial in affording a cheap supply of electric power such as is now essential to English industries to enable them to meet foreign competition, and that it is impracticable for the municipalities themselves to afford such a supply. As mentioned, the opponents of the Bills are endeavouring to secure their defeat on second reading, while the supporters hold that they should be allowed to go before a committee, so that they may have an opportunity of proving by evidence the necessity of some such measures. A favourable precedent is the North Metropolitan Electric Power Bill, which passed second reading on Monday last.

**The Cause of a Great Fire.**—Commander Wells's report on the fire which destroyed the Grand Theatre at Islington this week, says, "Cause of fire, gas lighting." Need we point the moral?

**The Blackheath Shock Fatality.**—At the Blackheath and District Electric Lighting Company's works, East Greenwich, on Thursday last week, an electrical engineer named Samuel Robert Harvard accidentally put his hand on a spring on the switchboard, with the result that he received an electric shock which killed him. Mr. Harvard was a fully qualified engineer, and was, until recently, in the employ of Messrs. Johnson & Phillips, electrical engineers, of Charlton. At the inquest, held on Friday last by Mr. E. M. Wood, deputy coroner, Mr. Harvard's father said his son had been only three days in the service of the company, but he had complained to witness of the imperfect state of the platform on which he worked. Mr. J. A. Constable, assistant engineer of the company, said Mr. Harvard's duty was to regulate the voltage of a machine of 2,750 volts. He should not touch the metallic part of the switches. The metal of the switches above the handle was exposed. If the floor had been an insulated one there would have been extra protection against the current passing through a man's body. An India-rubber mat or a dry wood covering would have served, but the consulting engineer had not thought these things necessary. The medical evidence showed that there was a cauterised wound on the knuckle of the left forefinger. The current had passed through the body, the heart was emptied of blood, and several small blood vessels had been shattered. Death must have been instantaneous. The jury returned a verdict of accidental death, and expressed the opinion that the floor should have been properly insulated. The coroner rendered this as "Accidental death, due to the absence of proper protection by the employers." The company's solicitor protested, but the jury agreed with the coroner's wording.

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**The Electrical Volunteers' "Send-off."**—We would remind our readers that the "send-off" dinner to the active service contingent of the Electrical Engineers (R.E) Volunteers will take place at 7.15 for 7.30 p.m. to-morrow (Saturday, March 3rd), at the Princes Restaurant, Piccadilly. Chairman, Lord Kelvin.

The detachment of the Electrical Engineers Volunteers who are to go out to South Africa to work the electric search-light apparatus will consist of two captains, three lieutenants, two sergeants, four corporals, four second corporals, and 36 sappers. The *Times* says that they will be accompanied by Captain F. L. Lloyd, R.E., chief instructor of the Plymouth School of Submarine Mining, and a sergeant-major and sergeant of the Royal Engineers. It is expected that the corps will embark early in March, after a brief preliminary practice in the neighbourhood of Chelmsford.

It is announced that the active service contingent of the Corps will be paraded on Saturday afternoon (March 3rd) at the temporary camp in Chelmsford, and will be glad to exhibit to any of their friends who can be present the plant which they are to take to South Africa. The train leaving Liverpool Street at 2.25 p.m., for Chelmsford is recommended. Special carriages will be provided on the train leaving Chelmsford at 5.55 p.m. to convey the officers and men who are coming to London to the dinner, and covered brakes will meet the train at Liverpool Street to convey them to the Princes Restaurant. Major Crompton will be happy to give facilities to visit his works at Chelmsford to any of the party who are able to go down by an early morning train.

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**City and South London Railway.**—The Moorgate Street extension of the City and South London Railway was inspected by Sir Francis Marindin, on behalf of the Board of Trade, on Saturday last, and the line was open for traffic on the following day. The King William Street station has been closed, and new stations opened at London Bridge and the Bank. The change was attended with complete success, and the traffic has been maintained without a hitch of any kind. This is the more noteworthy, seeing that the occasion is signalised by the successful adoption of the three-wire system of electric traction; in this respect the undertaking is unique. Attempts have been made to apply the system to surface tramway working, but have met with no success. In the present instance the conductors in the up and down tunnels are maintained at a potential difference of 1,000 volts, while the rails are connected together to form the neutral conductor; it is thus impossible for any person to receive a shock on the line at a higher pressure than 500 volts. In order to supply the City end of the line without serious loss, the pressure is further increased to 2,000 volts for transmission direct to London Bridge, where direct current transformers and a battery of Tudor accumulators are installed.

Extensive additions have been made to the generating station at Stockwell, where a battery of nine Davey-Paxman "Economic" boilers has been put down, with automatic coal-handling machinery, to supply steam to two horizontal compound Corliss engines, made by Messrs. Cole, Marchant and Morley, of 1,100-I.H.P. each, driving two 12-pole dynamos of the Electric Construction Company's manufacture, as well as to two 500-I.H.P. and two 250-I.H.P. Willans-E.C.C. steam dynamos. The switch gear is of more than ordinary interest, on account of the precautions which have been taken to absolutely prevent the possibility of error in coupling up the dynamos. This also is the Electric Construction Company's work. Sufficient plant is now available for running the extension to Clapham, which is nearly complete, and progress is being made with the additions necessary to cope with the traffic when the Islington extension is ready. The five lifts at the Bank station, capable of conveying 340 passengers, and the lifts at the other stations, were made by Messrs. Easton, Anderson & Goolder, Limited, and are worked by electricity. The ordinary ticket system of fares has been adopted instead of the turnstile system. The whole of the extensions of the line were carried out by Messrs. Mowlem & Co., the engineers being Sir Benjamin Baker and Mr. David Hay.

We are happy to remind our readers that *the whole* of the work has been carried out with British material, labour, and supervision, and that the railway itself was the first underground electric railway, not only in this country, but in the world. We must also congratulate the engineer, Mr. P. V. McMahon, on the complete success which has attended his efforts, especially in the application of the three-wire system, which was so fully discussed at the Institution some time ago. We look forward to seeing the railway enter upon an era of increased and permanent prosperity.

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**Physical Society.**—At the ordinary meeting, held on February 23rd, Prof. S. P. Thompson, F.R.S., foreign secretary, in the chair, Prof. R. W. Wood, of the University of Wisconsin, U.S.A., exhibited and described "Photographs of Sound Waves and the Kinematographical Demonstration of the Evolutions of Reflected Wave-fronts." The sounds were produced by electric sparks and photographed by means of the light emitted by carefully timed subsequent sparks, according to the method described in the *Phil. Mag.* for last year.

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**Lectures.**—At the Friends' Meeting House, Bishopsgate, Without, on the 22nd ult., Mr. Frank Tandy, A.I.E.E. (G.P.O. engineering branch), gave a lecturette upon "The Development of X Rays." The subject was illustrated by experimental demonstrations, which were carried out by Mr. George Taylor, the induction coil being kindly loaned by Mr. Fleetwood, superintending engineer G.P.O.

At the Royal Photographic Society's meeting on Tuesday, a paper on "Electricity in Connection with Photographic Action," was read by Mr. W. Friese-Greene.

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**Röntgen Society.**—Before this Society on Thursday, a paper was read by Mr. J. H. Gardiner on "Measurements of the Absorbability of Röntgen Rays." Dr. Hugh Walsham showed skiagrams of two cases of renal calculus before and after removal. Among the future arrangements are the following:—April 5th.—Dr. Norris Wolfenden and Dr. Forbes Ross: "The Influence of the X Rays upon the Growth and Development of Micro-organisms." May 3rd.—Dr. Dellpratt Harris, a short paper "On a Form of Focus Tube designed to be Self-heating."

**Electric Power Developments.**—The *Glasgow Evening Times* says that for many years the locomotive works in the Springburn district have been endeavouring, with more or less success, to reduce the amount of smoke issuing from their furnaces. Recently, however, improvements have been carried out in the Hydepark Works of Messrs. Neilson, Reid and Co., and are about to be undertaken by Messrs. Sharpe, Stewart & Co., Atlas Locomotive Works, which should prove a still more effectual remedy. This is the introduction of electricity for lighting purposes, and also for driving the machinery. The contract for fitting up the Atlas works has been given to a Newcastle firm. A start was made this week, and the installation is expected to be completed by the end of July. It is said that the introduction of the electric power will mean a saving to the extent of £3,000 per annum in the coal bill in the one establishment, and considerably more in the other.

**Personal.**—We read in an American exchange that Mr. Frank E. Musgrave, of Musgrave & Sons, Limited, of Bolton, and Mr. Gregory, the chief engineer of the company, returned to England on February 10th, after having spent a week in the States inspecting some American power stations.

Lord Rayleigh, Lord Lieutenant of Essex, has appointed Mr. W. Lloyd Wise a Deputy Lieutenant of the county.

**Forthcoming Marriage.**—A marriage is arranged and will shortly takely place between Mr. Henry Bligh Forde, A.M.Inst.C.E., chief cable engineer of the Norddeutsche Seekabelwerke, Nordenham, Germany, and formerly of the firm of Clark, Forde & Taylor, Great Winchester Street, E.C, and Hedwig Alice, second daughter of Baron and Baroness von Dieskau, of Rettershof, Eppstein im Taunow, Germany.

**To the Front.**—The surrender of Cronje, the ablest, and at the same time the most dangerous of the Free State commanders, and his horde of misled (in more ways than one) followers on the anniversary of the Majuba Hill disaster, and the relief of Ladysmith two days later, will afford the liveliest satisfaction to every loyal subject in England and her devoted Colonies, and nothing better could have occurred to still further heighten the patriotism, too long dormant, of the old country. The modest function which takes place to-morrow evening for the purpose of wishing God speed and a safe return to the Electrical Engineer Volunteers who are going to the front with Major Crompton, will be immensely aided by the glorious news, and the spirits of the handful of gallant fellows who are leaving all they hold dear behind them for their country's sake will be elevated and their determination strengthened by the thoughts of the brave deeds which have brought relief to a beleagured garrison, and given a death blow to the audacious pretensions of Messrs. Kruger and Steyn.

**The Northern Society of Electrical Engineers.**—The annual general meeting of this Society was held on Tuesday, February 27th, at the Grand Hotel, Manchester. The amalgamation with the Institution of Electrical Engineers was arranged, and the new President, Dr. Edward Hopkinson, read his presidential address. On Tuesday, March 13th, a paper will be read by Mr. A. H. Gibbings on "Electric Driving in Factories."

**The late Prof. Hughes and the Royal Society.**—We read in a daily paper that the late Prof. D. E. Hughes, F.R.S., has bequeathed £4,000 to the Royal Society for the furtherance of physical science.

**Electrocution.**—The New York correspondent of the *Morning Leader*, describing an electrocution on Monday, at Sing-Sing, says that the subject was placed in the chair, and the electric currents of immense voltage sent through him at intervals caused death only after the fifth application.

**Obituary.**—We regret to announce the death, which occurred on February 23rd, of Mr. Emile Andreoli, whose name is familiar to all our readers.

**The Royal Society.**—Among the papers read yesterday afternoon was one by Prof. J. Zeleny on "The Velocity of the Ions Produced in Gases by Röntgen Rays."

**Institution of Junior Engineers.**—The summer meeting of this Institution for 1900 is to take place in Newcastle-on-Tyne and district, from August 11th to 18th.

## NEW COMPANIES REGISTERED.

**Electra House, Limited** (65,026).—This company was registered on February 13th, with 20 members, each liable for £10, to acquire, turn to account, and deal with lands, buildings, and property in the City of London or elsewhere. The first subscribers (each with one share) are:—A. J. L. Cappel, K.C.I.S., Winchester House, E.C.; J. D. Pender, Winchester House, E.C., gentleman; F. A. Johnston, Winchester House, E.C., gentleman; G. Draper, Winchester House, E.C., secretary Eastern Telegraph Company, Limited; J. E. Hesse, Winchester House, E.C., manager Eastern Extension, Australasia and China Telegraph Company, Limited; W. H. Axworthy, Winchester House, E.C., manager Western Telegraph Company, Limited; and R. Hardie, Winchester House, E.C., accountant Eastern Telegraph Company, Limited. The number of directors is to be three; the first are J. D. Pender (nominated by the Eastern Telegraph Company, Limited), C. S. Colvins (nominated by the Eastern Extension, Australasia and China Telegraph Company, Limited), and D. H. Goodsall (nominated by the Brazilian Submarine Telegraph Company, Limited).

**Imperial Automatic Advertiser, Limited** (65,033).—This company was registered on February 14th, with a capital of £20,000 in £1 shares, to carry on the business of advertising, electrical engineers, manufacturers and contractors, and in particular to acquire certain patents under an agreement with F. Fanta. The first subscribers (each with one share) are:—D. O. Brown, 84, Clapham Road, S.W., accountant; J. H. Whitchurch, 40, Alexandra Road, Hornsey, clerk; C. P. Elms, 26, Birstall Road, South Tottenham, N., clerk; P. J. Holdsworth, Stanway Lodge, Salisbury Road, Bexley, clerk; J. C. Coates, 302, Gascoigne Road, Barking, clerk; C. Yeomans, 20, Appold Street, Finsbury, E.C., printer; and E. C. Bowtell, 39, Brooke Road, N., clerk. The number of directors is not to be less than three nor more than seven; the first are to be appointed by the subscribers; qualification, 100 shares; remuneration, £150 each per annum (£50 extra for the chairman) and a share in the profits. Registered office, 11, Ironmonger Lane, E.C.

**Electro-Chemical Company (1900), Limited** (65,041).—This company was registered on February 14th, with a capital of £200,000 in £1 shares, to acquire the business now carried on by the Electro-Chemical Company, Limited (incorporated in 1894), to enter into an agreement with the said old company and Robert Shaw, the liquidator thereof, to acquire any chemical, carbon and alkali works, and to manufacture, prepare and deal in (both wholesale and retail), caustic soda, soda ash, bleaching powder, chlorate of potash, sulphuric and hydrochloric acids, carbon, and all other substance and things which can be manufactured or prepared under the company's patents. The first subscribers (each with one share) are:—T. J. Holland, Mount Ephraim House, Tunbridge Wells, C.B., D.L., Col., retired; R. Vogan, The Beeches, Guildford, corn merchant; L. Evans, Barnes Lodge, King's Langley, paper manufacturer; E. Taylor, 22, Park House, Ealing, gentleman; W. Dedrick, The Cottage, Handen Road, Lee, Kent; R. Shaw, 62, Cooper Street, St. Helens, Lancashire, secretary; T. M. Knockholt, gentleman; and R. Smith, Westwood House Villas, Snodland, Kent, cashier. The number of directors is not to be less than three nor more than nine; the first are T. Holland, L. Evans, M. H. Pirie, T. M. Dunster, J. H. F. Walter, and R. Vogan; qualification, £1.000.

**Dialene Rubber Company, Limited** (65,105).—This company was registered on February 20th, with a capital of £15,000 in £1 shares, to adopt an agreement with George E. Heyl-Dia for the acquisition of certain secret processes for the manufacture of rubber out of old and used rubber, by means of chemical treatment, to manufacture and deal in "Dialene" rubber, to apply the said processes to the insulation of telegraphic, telephonic, and electric cables, wires, and appliances, and to carry on the business of rubber manufacturers and merchants, makers of rubber goods and articles, &c. The first subscribers (each with one share) are:—Frank Reddaway, Cheltenham Street, Pendleton, Manchester, manufacturer; Herbert Walmsley, Beechfield, Leyland, manufacturer; George E. Heyl-Dia, Higher Broughton, Manchester, electrical engineer; Herbert Hodgkinson, 35, Highgate Terrace, Fulwood, Preston, cloth manufacturer; Lambert Reddaway, 138A, Duke Street, Southport, manager; William H. Cresswell, Woodley Bank, Woodley, Cheshire, manufacturer; and Francis B. Craven, 59, Holborn Viaduct, E.C., gentleman. The number of directors is not to be less than two nor more than seven; the first are George E. Heyl-Dia, William H. Cresswell, Herbert Walmsley, and Lambert Reddaway; the two first-named are permanent managing directors; qualification, 500 shares; remuneration of managing directors according to profits; others as fixed by the company.

# CITY NOTES.

## Charing Cross and Strand Electricity Supply Corporation.

The annual ordinary general meeting of the shareholders of this company was held on Tuesday at the offices, 15, Maiden Lane, Covent Garden, Mr. W. F. Fladgate presiding.

The Chairman, in proposing the adoption of the report and accounts, said the directors had an exceedingly satisfactory story to tell. Last year they considered that their position was a good one, and that the progress they had made was equally satisfactory; but this year they came before the shareholders with an increased income, with a more fully developed business, and with reserves very largely increased. The report and accounts spoke for themselves, and he would not dwell upon them; but there were one or two matters connected with the company to which he wished to call their attention, and the first, and probably the most interesting, was the increases which they had made during the year. Their sales for 1898 amounted to 3,241,000 units; for 1899 they amounted to 3,862,000 units, an increase of no less than 15,000 units, or 19 per cent. upon the whole sales, and he could not help thinking that that alone showed very clearly how the company had been able to maintain its reputation in the districts it was supplying. The number of lamps hung, which, of course, increased as the sales increased, was again very remarkable. In 1898, which was a good year, they increased the number by 26,000; in 1899 they increased the number by no less than 48,000, which he thought was a very startling amount to be able to record. Their largest increase was where they naturally expected it would have been, viz., in the Strand district, because in St. Martin's, although there had been a considerable increase in the year, it must be remembered that they had had possession of that district for many years, and had more or less exploited it, whereas the Strand district was only taken up a few years ago. Although there was still room for considerable expansion in the St. Martin's district, their largest increase last year was in the Strand. In the first year of their working in Holborn and St. Giles's they practically did little or nothing, but this past year they had done a considerable amount of work, and he thought that those districts gave promise of bearing good fruit and rewarding them for the trouble they were at in getting the provisional order. The result of the sales was again satisfactory. In 1898 the result was £59,000, in 1899 £69,700 or £70,000. That was a very substantial increase, and in considering that increase he called their attention to one item which had been a matter of comment before in that room, and that was the expenditure on coal. For some time they had not been by any means happy as to the amount of coal they were consuming. They thought they were consuming more than they ought, and one reason for that was the fact that some of their boilers were not working in a satisfactory way. They hoped and believed that they had put an end, to a great extent at least, to that difficulty, and that was proved by the fact that despite the largely increased amount of work which they had done in 1899 over 1898, the actual coal consumption was 104 tons less, and that result might, he thought, be considered satisfactory. Unfortunately, coals had increased in price last year, but if they had remained at the same figure as in 1898, it would have meant a sum of £3,392 in the shareholders' pockets. The net result of the year's working was that the net profit for 1899 amounted to £27,677, against £21,377 for 1898, and that he thought was a satisfactory result. It had been arrived at after making due provision for repairs of stations, mains, &c., and the keeping of the mains in the very highest state of efficiency, and no less than £5,000 had been thus spent. In addition to that expenditure they had put aside £8,000 for depreciation of machinery and plant, against £7,000 in 1898, the increase being consequent upon their having increased their machinery. They were able to recommend a dividend at the rate of 9 per cent. per annum, and that, he thought, was a very fair return. The capital account stood at £350,000 with practically no debenture debt whatever. They did not consider it necessary to deal with the debentures last year, but they would have to deal with the question this year at a special meeting. The result of the issue of shares in the beginning of last year was, that they were able to add £99,000 to the share premium account. They had placed £9,000 of that to capital reserve account, and seeing that their Lambeth premises were leasehold, they had set aside £5,000 on that account, which left them £85,000 to bring forward to the share premium reserve account. The result was that their reserves at the present moment amounted altogether to £137,000 or 40 per cent. of the share capital. They had put that reserve into the business, which they considered the most sensible thing to do. At the present moment the company had three stations actually in working order—Lambeth, Maiden Lane, and Short's Gardens. They were all in working order, although Lambeth was not yet complete, and there was some work to be done at Short's Gardens, but their present capacity at those stations was 250,000 lamps. Their present supply was 190,000 lamps; they had therefore a surplus of 60,000 to deal with the increase of business which they might expect in the next few years. But in order to comply with the demands upon them from their districts, wholly irrespective of the City, they would have to spend large sums in mains, machinery, and on other stations. During the past year their customers had increased by 300. With respect to the City, as they were aware, the Board of Trade inquired most fully into the requirements of the City, and after a most exhaustive inquiry Sir Courtenay Boyle reported in favour of their company being given the City. That decision was confirmed by Parliament, and they had succeeded in getting their order. As to the value of that order to them personally he had no doubt. As to the way in which they were going to work it, that had been a matter of very grave consideration by the board, and they had arrived at a conclusion on the subject, the particulars of which would be put before them at a special meeting. One important point of the order was that it enabled them to get a very large area of supply. That large area would enable them to make it worth their while to equip and build a large station in order that they might compete not only with the City, but also with the West-End districts they were supplying. They had made arrangements for acquiring a large block of land of over 7½ acres at Bow, and they were promoting a Bill in Parliament for the purpose of getting powers to run their mains from that station to the City, through the City to the existing stations, and thus to be able to link up the whole of their stations, and make the one supplement the other. Under their City order they were bound to give them a separate supply, and that would be provided for on the land they had acquired. The position as to capital was that all the present capital had been issued, and the power to issue debentures was limited to £150,000. In all probability—without committing himself definitely—they would ask the shareholders to increase the whole of the share capital, both ordinary and preference, and to increase the directors' power of borrowing upon the capital. They would make up their minds as to what amount would be necessary to fully complete their works over all their districts, and probably they would suggest a separate sum of, say, £200,000 for the City.

Mr. G. H. Brougham Glasier seconded the motion.

Some discussion ensued, Captain Watson remarking that he hoped the City venture would be made a separate affair, as he was afraid it was rather a "wild cat" scheme. The City Company would be sure to undercut them in price, and, being in possession, would stand the best chance.

The Chairman, in reply, said he would rather not enter into a discussion upon that question then, but leave it to the special meeting, which would be called within a month of that date. All he could say was that their policy of increasing their areas had been justified by results in the past, and he fully believed it would be the same with the City.

The report was then adopted.

## Central London Railway Company.

Sir Henry Oakley (chairman) presided on Wednesday last week over the half-yearly meeting of the above company, and, in moving the adoption of the report, said that they had now 1,911 shareholders as against 1,894 last year. They would observe that the whole of the capital had been called up and practically paid; the whole of that capital might be said to have been paid in good honest sovereigns with no discount allowances or rebate of any description made to any shareholder, and the money, he might say, had been as faithfully expended as it had been promptly paid. There was one point they would observe, which was that they had not raised any of their loan capital. They had purposely avoided doing so, because they were advised that they would get a much better price for their 4 per cent. bonds after the railway was opened than before, and those who made arrangements with the contractors also made this part of the contract—that the proportion of the payment they were to take in bonds should not bear interest until the railway was open. There was a large sum due to the contractors on that account, and they looked upon it as being one of the greatest possible incentives to the contractors to get their work done as quickly as possible, because until they did there would be a large sum outstanding on which they got no ifterest. The only special item in the accounts was that of £10,028 for additional land at the Marble Arch, which they had acquired to give better ingress and egress at the station, which they hoped would be a very busy station. By acquiring this additional property they would be able to improve the superstructure, which would be built either by themselves or someone else over the station, and would bring them a valuable income in the way of rent, or a substantial sum by way of ground rent. He might mention generally with regard to the superstructures over their stations, that the board had decided that they would not enter upon any new expenditure or cumber themselves with any new work until the railway was opened. They had 11 sites for their booking offices in admirable parts of London, and they trusted that these would prove a considerable source of income. But the point which interested them was the completion of the railway, and that was what the attention of the board had been daily directed to for the past six months. Speaking for himself, he certainly had hoped that the railway would have been opened before now, but that had not been achieved. Their engineer and contractor assured them that every possible effort was being made to ensure its completion, but owing to the difficulties of construction and the impossibility of reaching the line below the surface except through the shafts sunk at the stations, the work must necessarily be slow, and until the whole of the heavy work in the lower levels had been completed, no steps could be taken to fit up the lifts, or use the area of the ground floor for the purposes of the station for which they were destined. They had now arrived at the state, however, that the underground work from the Mansion House to Shepherd's Bush was completed, except as to the laying of the third or electrical rail, and that was in hand. The running rails in both tunnels were complete, and with regard to the other matter, he was assured by the representative of the great electrical firm which had it in hand, that there was a speedy prospect of that

being completed. The rail by which the electric current would travel had been delivered, but it had to be insulated, and had to be what was technically termed bonded. When that was completed, practically all the underground work would have been done. The work at the Bank had been arduous, but had been completed happily without disaster, and early in January the public subways had been opened. The lifts at the station were in hand, and six or seven of them had been completed, and when the electrical people had got their heavy work done the completion of the lifts would quickly follow, and they would then be able to bring the railway into practical use. At the Shepherd's Bush depôt they had large engine houses and machine shops, and carriage shops, and the heavy engines, driving to the amount of 12,000 H.P., had been erected and three had been tried. As soon as they could make a connection with the central rail they would run an experimental train, and they might reasonably hope to be able to run the experimental train shortly after the end of that month. But Sir Benjamin Baker would not give any date as to when the railway would be opened till the machinery had been tried, although if it realised his anticipations it would not be long. Referring to the Bill of the company to amend the Central London Railway Act of 1891, the chairman said they were asking to be allowed to issue 2d. return workmen's tickets, and allow workmen to return at any time of the day, instead of having to run three workmen's trains in the morning and three in the evening.

Lord COLVILLE seconded the motion for the adoption of the report.

Replying to various questions, the CHAIRMAN said the board had considered the question of the consolidation of the shares, and it was suggested that it would be desirable, but they would make further inquiry. He could not announce yet what the fares would be, because it was a matter which wanted very careful consideration. They would complete the undertaking practically within the original estimate, and the board had no reason to doubt that they would be well able to pay their way.

The report was adopted.

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## W. T. Henley's Telegraph Works Company.

THE meeting of this company was held at Cannon Street Hotel on Wednesday, Mr. S. Gedge, M.P., presiding.

In moving the adoption of the report and accounts, the CHAIRMAN referred with regret to the death of Major-General Hutchinson, a director, whose place had been filled by the election of Sir H. M. Stanley. Referring to the report, he thought that they would consider a 15 per cent. dividend highly satisfactory. In the accounts the liabilities were, as usual, put at the outside figure and the assets at the inside. The expenses of the issue of new capital had been charged to income instead of to capital, and the same remark applied to the improvement of the offices. They were adding £10,000 to reserve out of profits, nevertheless that reserve was £20,000 less than at the end of last year. With reference to the reserve under cable repair contract of the Bahamas cable, that cable, like the two other great cables in the West Indies—the Halifax and Bermudas, and the cables between the West Indian Islands and South America—had maintained their position during the year without incurring any expense for repairs. A number of the company's men who were Reservists had gone to the front, and they would be taken back when they returned, and their relatives were being taken care of while they they were away both by the company and its employés, who were making weekly subscriptions. The manufacture of golf balls had fallen off—due to the war. The chairman next referred to the change that was last year effected by raising £90,000 new 4½ per cent. preference capital and getting rid of the 30,000 7 per cent. preference shares for £60,000. The whole of the share capital was taken up by shareholders and nominees without underwriting or advertising. In 1896 the capital was £180,000, but to-day it stands at £350,000; but this increase of capital should cause no alarm, for the increase had not only been necessary and judicious, but the results were better than anticipated therefrom. While, in 1896, the land, plant, buildings, and stock stood at £196,000, the value of those items to-day is £381,000, an increase of £185,000, against £170,000 increase of capital. He hoped and believed that for several years to come the capital account was closed. The business was a very steady, quiet one, and if any big contract came along for which additional money was wanted, they could raise it at the bankers, without issuing fresh debentures, for the short time it might be required. With only £50,000 debentures, they would always be able to borrow what they might require for temporary purposes. Shareholders might think they ought to have more than 15 per cent., but they did not think it wise to divide more. It would be remembered that they were obliged to diminish the reserve fund by £30,000 for the issue of the preference shares. They must go on building up a reserve fund in case accidents happened or a great rise in prices occurred, which might make it difficult to pay 15 per cent. The reserve fund was £42,500. The prices of materials, gutta-percha, India-rubber, and copper, had risen very considerably, and that tended to diminish profits, and wages were not falling. After referring to the ability, skill, and attention of Mr. Sutton, the managing director; Mr. Hatton, the works engineer; and Mr. Salmon, the secretary,

The adoption of the report was seconded by Mr. DRISDALE, and after several questions had been asked by shareholders and answered to everybody's satisfaction by Mr. Sutton, the report was unanimously adopted.

Mr. SUTTON's remarks showed that the land was included in the accounts at the price it was worth at the company's inception, but to-day it was far more valuable. Patents were only set down as £1,000, but he thought that if they copied some other companies in valuation in this respect, £100,000 would be nearer the right figure. The chairman's remark that the capital account was closed for three or four years, did not mean that they were not going to make any progress. They had many schemes to carry out, but had not the capital. It was hoped that in the next few years they would earn the capital and pay it out of profits. It was a question of putting to reserve or increasing the capital. The stock was very carefully valued by the staff and officials, not by professional valuers. The stock was worth considerably more than it appeared at because of the increases in prices of materials. They had a very large stock of gutta-percha, the largest they had ever held. The price had gone up 100 per cent. in the last two years. Some, which cost them 4s. or 5s., was now worth between 7s. and 8s.

The resolutions declaring dividends, re-electing directors and auditors, and thanking the directors, officials, staff, &c., were unanimously passed.

In reply to a SHAREHOLDER, who asked as to the business done in January and February as compared with last year, the CHAIRMAN said that the business was going on steadily, but there had been no big order. The ordinary bread-and-butter business was rather better than last year. The sum total of the orders was not quite so large, because there was one rather big order last year which mounted up the business.

Mr. SUTTON said here was more work on the machines than at this time last year, because they were carrying forward a very large number of orders from 1899.

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## Telegraph Construction and Maintenance Company.

THE meeting of this company was held on Tuesday at the offices in Old Broad Street, Sir Robert Herbert presiding.

The CHAIRMAN moved the adoption of the report, a brief abstract of which was published last week, but which also stated that "The business of the company has been satisfactorily maintained during the past year. The factories have been fully occupied in the manufacture of submarine telegraph cables and of insulated wire, whilst the company's steamships have been actively engaged in the laying of cables, as well as on repairing operations. The factories at East Greenwich and Wharf Road and the company's steamships are in a thorough efficient condition."

The CHAIRMAN stated that the directors were pleased to be able to submit a somewhat better statement than in the two preceding years. The company had now returned to the condition, approximately, in which it was in 1896, when the net profits were £92,854, those for the past year having been £92,348. The total of the figures in the balance-sheet was larger than it had been in previous years, this being attributable to the much more extended operations of the company. On the one hand, they had received much larger sums than in the last two previous years for the work that had been carried out by them; but on the other hand, they had had to expend much larger sums in the purchase of material, in wages, in the navigation of their ships, and in the laying of cables. The cost of materials had very largely increased during the past few years, and there was no apparent prospect of their falling. It was satisfactory to recommend the carrying forward this year of £53,803, a larger sum than they had carried over since 1894. In view of the uncertainty of the business in which the company was engaged, a considerable sum ought to be carried forward. After paying a dividend of 15 per cent., tax free, they would carry forward the sum he had mentioned. The factories were in excellent working condition. Improvements had been and were being made in both of them, which necessitated a considerable outlay, and they were also being made much more efficient for the execution of the best class of work. Provision for this had been made in the balance-sheet. The ships were in exceedingly good condition. The *Anglia* had completed the laying of the cable from St. Vincent to Ascension, which was the second section of the total line from St. Vincent to the Cape, and the work had been admirably done. The steaming and working qualities of the vessel had established quite a record; she laid the cable at the rate of over 7 knots on the average right through, including stoppages for various purposes. He did not think that a first-class cable had ever been laid with such rapidity and such perfection as the one in question, and the manner in which the cable worked, and its first-rate quality, were highly satisfactory. They proposed to add a further £5,000 to the pension fund. They found that the scheme proposed would require a rather larger subsidy than the £5,000 already voted. This scheme was now being revised, and when this work was done, they would be able to present the employés with a good pension system, which would need very little further support from the shareholders. There was a considerable amount of work in hand, and the directors hoped to be able to earn fair profits in the current year. About 40 of the company's employés had joined the forces in South Africa, and the company had acted in the same liberal way in this matter as other great companies had done. They would take the men back on their return, and would give them liberal treatment. Although he did not himself consider that the company were making the best profit at that particular moment on the cables they were constructing, they were not doing badly; they were getting fair prices, which were remunerative. They had been fairly met in this respect by those for whom they had been doing work.

The adoption of the report was seconded by Sir JAMES PENDER, and carried unanimously.

Sir Robert Herbert and Sir J. Pender were re-elected directors, and Messrs. J. Gane & Clegg were re-elected auditors.

Responding to a vote of thanks to the directors and staff, the CHAIRMAN said that the whole of the staff had been very hard pressed during the last year with a great amount of construction and laying of cables going forward, and had covered themselves with

credit. He congratulated shareholders that the cable just laid by them to South Africa had been the bearer of a piece of good news which had thrilled England, namely, the capitulation of Cronje. It was a good cable and worthy to carry good news.

## Edison & Swan United Electric Light Company.

An extraordinary general meeting of this company was held at Westminster Palace Hotel on Tuesday for purposes which were outlined in the notice published in last week's Electrical Review.

The Chairman (Mr. J. S Forbes) proceeded to explain the position of the company, and he went at considerable length into its past history, showing the effect that the expiry of the lamp and the lampholder patents had upon the profits. The profits fell from £27,000 in 1894 to £16,704 in 1896, a fall of £11,000, but in 1897 the business began to expand because they pushed it in the face of competition when the electrical business was expanding very rapidly. In 1897 the profits got up to £20,000 and in 1898 to £26,700, but at the end of 1898 the lampholder patents, which had given for several years £8,000 a year, disappeared. The company therefore emerged into the open market into much more severe competition. But the profits in the last accounts came up to £32,200. They had great pressure to supply the demand for electrical apparatus. The character of the business had been greatly changed, for they were now making dynamos, electroliers, and everything required for electric light installations, instead of lamps only. Expansion meant locking up money. Installers of electric lighting plant were very often themselves short of capital, but others were well to do, though governed by the custom of the trade, which was to keep manufacturers waiting a long time for their money. Their last balance-sheet showed sundry debtors and debtor balances, £90,000, which locked up a very large sum in proportion to the whole income. Then they were obliged to keep supplies of great varieties of things in stock for their customers to select from. The last balance-sheet showed £168,000 locked up in that way. They must have more money if they were to go on. One disadvantage was that if they could not get their money in, they could not pay the people who supplied them with materials for their work. They had always had the advantage of getting good things upon moderate terms, but that absorption of their floating capital in financing other people, and locking up those enormous stocks, had the effect of the company getting into debt, not having been able to pay its bills. They owed the bankers over £40,000, and there were tradesmen's bills outstanding. It was necessary that they should have more money at command. If they had more money they would have done a larger and more profitable business. He believed that if they faced this thing, and had means ready when they wanted them, they had a very large future before them. After much deliberation they came to the conclusion that the most rational way was to raise debentures. For some unaccountable reason the shares were at a discount in the market, and then the "B" shareholders, who represented the interests of Mr. Edison and his friends, who sold their patents to the original Edison Company for shares were entitled, by the conditions of the bond, to one share free for every three issued. That would be an improvident arrangement, and after considering this and other matters, they resolved upon issuing debentures. They had decided to take power for £300,000 5 per cent. second debentures, but only £100,000 would be issued during the present year, £100,000 next year, and the remainder with the consent of the trustees. He then moved:—

That the directors be and they are hereby authorised to create and issue debenture stock, providing for the payment of principal sums, not exceeding £300,000, and carrying interest at the rate of not exceeding 5 per cent. per annum. Such debenture stock to be secured in such manner (subject to the existing debenture stock already issued by the company to the amount of £350,000), and to be issued to such persons and on such terms as the directors shall think fit.

The Earl of Lichfield seconded the resolution, which was carried, there being only two dissentients, and these represented the "B" shareholders who wished to place on record their protest against the issue of debentures.

## Wireless Telegraph and Signal Company.

The meeting of this company was held last Friday at Cannon Street Hotel for purposes which have been already mentioned in the Electrical Review. Major Flood Page presided.

In moving the adoption of the report and accounts to August 31st, 1899, the Chairman made a very lengthy general statement regarding what had been accomplished in wireless telegraphic communication, and what were the directions in which it would prove of value. We have not space to spare to print the speech in full, and furthermore, most of our readers are already fully versed in these matters. We, therefore, make the following abstract from the Major's remarks. The capital of the company was shown in the accounts as £200,000, of which nearly £125,000 had been paid. On the other side they would see that, whereas the patents last year were in the account at £75,864, an additional expenditure had been made on them to the extent of £1,145, bringing up the value to £77,010. The number of patents last year were about 32, and this year they are about 100. However valuable the original patent might be, he was not exaggerating when he said that the patents that had been taken out since and are now being dealt with would be of greater value to the company than the original patent. They had in stock and materials, plant, &c., £5,440, and the expenditure for the two years amounted to £10,960. On the date on which the accounts closed there was a sum of £32,290 by cash at bankers. He (the chairman) was not connected with the company during the period with which the accounts dealt, but his investigations proved to him that the money had been well spent—necessarily spent, and contrasted with many other companies, the amount was extremely moderate. The year was undoubtedly one of experiment and development. With reference to the Trinity Board and the East Goodwins lightship, wireless connection was first made on December 29th, 1898, and was maintained until February 14th this year, and during that time there had not been in the Marconi system a single flaw or hitch. None of the company's men had been working it for many months past. It had been worked by the seamen on board the ship. One of the company's assistants was always on board to guarantee everything being conducted properly, but the Trinity House did not permit him to touch it unless it went wrong. Mr. Marconi had felt for a long time past that every problem that required solving with reference to lightship communication at 12 miles distance had been solved. They accordingly went to Trinity Board to notify their intention to move the apparatus from the lightship, but by a special request to Mr. Marconi they agreed to leave it until January 31st. A statement published in the *Times* to the effect that a French vessel got on to the Goodwins and was saved owing to wireless telegraphy, and a loss of £52,000 avoided, was traversed by the Trinity Brethren in a letter to that paper. The original writer in the *Times* was corroborated by other writers in other papers, but the Elder Brethren declared that "they were not aware that any single ship had been saved by means of any electrical communication between shore and any lightship since the first experiments were made, not only with reference to Marconi but all other experiments which had been made." This was a matter of the very greatest disappointment to the company. It seemed incredible that any reasonable man should doubt that more lives and cargoes were likely to be saved with such communication than without it. The chairman next referred to the steps being taken in Germany in regard to the adoption of the system in lightships, lighthouses, and on the largest of the North-German Lloyd steamers; the chairman referred to the success of the system at the naval manœuvres over distances of 70 miles between war vessels steaming 20 knots an hour. He regretted to say that they had been unable to come to an arrangement with the Crown as to what was to be paid for the use of the patent on Her Majesty's warships, and under the Patents Act of 1883 they would have to settle with the Treasury. He did not believe that the Treasury could or would do a crying act of injustice to the company. Continuing, the chairman said that he told the Comptroller of the Navy that if they could prove that large commercial shipping companies were willing to pay a certain specified price for the Marconi apparatus to be fitted on their ships, it would be impossible for the Government to maintain that the system was not worth as much on every one of Her Majesty's line of battleships as it was on the vessels of these companies, and on much smaller ships. He could answer for his colleagues, and say that when they did go before the Treasury, whatever might be the course of procedure, they would do their utmost to obtain justice, and if they did not obtain what they thought a fair price, they would take what steps were necessary to obtain a better price. He could not believe that anything like confiscation could be meant. There were statements in the papers to the effect that the company had sold the American patents. It was quite true that an agreement was entered into for the sale of those patents, and it seemed very much as if it was coming to pass. The very influential men on the other side of the Atlantic who were concerned in that agreement went so far as to register a company, but there was in the agreement an option, and after mature consideration they determined not to exercise that option. The negotiations were, therefore, broken off, but, at the same time, the company had not parted with them in anything like dissension, so much so that they had promised that when they were prepared to go forward again with respect to dealing with that matter in the United States they would give the gentleman who was the leader of these very influential men in New York the opportunity again of taking up the business. The shareholders knew how successful Mr. Marconi was with respect to the New York yacht races. The only information they got about the races on several days was through his system. But a very much more important matter than that was the relation between the Marconi system and the American Navy, and he had seen it stated that the American Navy were going to introduce another system, and were adverse to the Marconi system. He did not believe that there was any foundation for that, and he would read a letter from the United States Navy Department which was received by Mr. W. W Goodbody, a director, shortly after Mr. Marconi returned from the United States. The department expressed its thanks for the demonstration of the Marconi system of wireless telegraphy recently given before a Naval Board, and offered its congratulations on the success attained, and on the probable further perfection of the system. "The certainty of transmitting a signal under conditions impracticable with any other known method renders the Marconi system of great value. The department begs to express the hope that you will further perfect the system, and will be glad to learn in the future of any progress made in this direction." There was a very simple reason for Mr. Marconi not continuing the negotiations with the American Navy Department, namely, they asked certain questions, and the patents were not complete. In America there was no provisional patent, and the patents were not complete. They would be completed, however, and he had no doubt that when they were completed and ready to work they would be glad to accept the invitation conveyed in that letter by the Navy department at Washington and give them information, so that they might go on. Reference was made in the report to the sailing last November, under agreement with Her Majesty's War Office, for South Africa of six assistants with apparatus. On this point he must confess that it was a matter of very great disappointment to the board that the War Office were not a little earlier in coming to them and letting the assistants go out. It was painful to think how much had been lost owing to their not having had the apparatus in Kimberley or in Ladysmith. If General Buller had had

the apparatus with him and there had been one in Ladysmith he (the chairman) had no doubt that they would have been in constant daily and nightly communication with the town. They had, however, been outside all the time, and not only that, but they have had no poles. They could not get poles. Eventually poles had to be taken up to the front from Capetown. When their assistants went out the arrangement was that they were to operate at the base and in communication with the ships, but they volunteered to go to the front, feeling that that was the only place where they could be of any practical use. Stories had appeared in the papers that the system was unequal to the work owing to the iron in the hills. A gentleman who knew a good deal about it, wrote to him and said that "it was not the iron in the rocks that prevented the working, but the wood in the heads of those who thought that such a thing could possibly prevent its working." He (the chairman) could only repeat what Mr. Marconi said so well in his most admirable lecture at the Royal Institution a fortnight ago, that if he could get through 30 big ironclads at sea, it was not likely that a little iron in the hills could prevent him going to the Cape. They had to resort to kites, and when the air was so variable that at one place you could fly a kite, whereas 30 miles off there might not be wind enough to fly a kite, it was impossible to communicate. He had in his hands two letters, one from Pietermaritsburg, where they were doing nothing, and the other from De Aar camp, where they were getting up the poles, and were perfectly ready to use the apparatus, but practically it had not at present been of any great use. He was sorry that in this first great chance for a trial of the Marconi system better care had not been taken that more advantage should be made of it. Speaking perfectly honestly and straightforwardly, he could assure the shareholders of this, that there had been no breakdown of any kind in South Africa of the Marconi system when the conditions had been such as were necessary for its success. The chairman then proceeded to explain to the shareholders what a vastly important enterprise it was in which they were engaged. He divided it into four great heads: (1) *Telegraphy on land* (a problem for the future); (2) *Trans-ocean.* Mr. Marconi's experiments had disposed of the bugbear of the curvature of the earth which scientific men not long ago said prevented messages being sent across the Atlantic by this company's system. The German professor who knew most about wireless telegraphy, said there was not the slightest reason why messages could not be sent across the Atlantic. "It was a matter for the future and not for the present," said the chairman. (3) The *combination of land and water* [the Andaman Islands, a case in point also between the five Hawaiian Islands which were now going to be connected on the Marconi system, apparatus being now in course of preparation, and only plague at Hawaii had prevented the company's assistants going earlier. The company also had negotiations with reference to Brazil and Canada]. (4) *Maritime.* This, said the chairman, was the most important at the moment. The Post Office monopoly could not extend more than 3 miles out at sea, and if the company could speak 10 to 20 miles out to sea they could not be brought under the Telegraphs Act. It was a matter of greatest importance that they should at once get rates, rules, and regulations all the world over. If they had one class of rate for communication from a ship to the shore and another in another place there would be nothing but confusion. They must get international relations on this ground. There were rumours of the probability of the French Government calling a conference to deal internationally with this question. He hoped the company would deal with it before the Governments took the initiative. After many further remarks as to the importance of the maritime rights, he said that the directors were proposing that there should be an international company with the principal men on it being Belgians (as Belgium was a neutral State and a very successful financial centre). They had placed themselves in relation with gentlemen of the very highest possible position, and they were going to form a company for the purpose of dealing with those maritime rights. They were not going to part with any patent to them; they were only going to give them the right to exercise and use the patents for maritime purposes. Shareholders in this company would have the right to subscribe at par up to £100,000 in £1 shares. If they did not choose to have them, there was a body of guarantors who were willing to guarantee that amount of capital. Shareholders would receive a circular in a short time giving full particulars of the proposal. It was necessary that negotiations for land station rights in France and Spain should be conducted by a neutral body rather than an English company. He was not at liberty to divulge the names of the gentlemen.

The adoption of the report was seconded by Mr. Bannatyne.

Asked whether the board would complete the bargain with the International Company before conferring with the shareholders,

The Chairman said that he omitted to state that the capital of the new company would be dealt with thus:—This company would first receive £100,000 in fully paid shares without payment; £100,000 would be placed at the call of the Wireless Telegraph shareholders, if they chose to subscribe; £145,000 would be at call of those gentlemen who guaranteed the £100,000. Only £25,000 would be called up at first. He was going to propose a resolution asking the shareholders to give the board permission to proceed with the scheme.

Mr. Smith, a former director of the company, said that they had listened with very great patience to the chairman. Thirty minutes of the time had been taken up with reminiscences of the company with which they were mostly familiar; 15 minutes was occupied telling them something about what the company *hoped* to obtain some day; and in the remaining two or three minutes they were told of the only tangible bit of the whole subject, namely, a mention of some negotiations in progress for the transfer of the maritime rights. They had heard nothing of any tangible results. The balance-sheet showed a year of very large expenditure, and nothing had been said as to any receipts! No mention was made of the earnings of the company, or what they would be in the future. Shareholders had been very patient indeed, but they could not live much longer on mere expectations.

The Chairman, replying to these and other remarks, said that there was not a single electrical company that had paid, and continued to pay, a satisfactory dividend in its first two, three or four years. They had sold, they thought—not absolutely sold—a patent for a distant country in a very successful manner.

The report was adopted, and the retiring directors and auditors re-elected.

The Chairman then moved "That the directors be empowered to proceed with the negotiations referred to in the address of the chairman."

The Chairman said that this Company would have the sole right of manufacturing the apparatus used by the International Company, and he hoped that in two or three years they would have built up a large manufacturing business. He mentioned that the representatives of this company on the board of the International Company would be Mr. Marconi, himself (Major Flood-Page), and one other director.

Mr. Marconi seconded.

After some discussion, in the course of which Mr. Smith again strongly criticised the action of the board in this matter, the resolution was carried by 12 votes to 6, a number not voting.

Other resolutions, printed in our last issue, were also passed with a slight alteration, the £1 per cent. in Article 68 being altered to £5 per cent.

## National Telephone Company.

The twenty-fifth ordinary general meeting of the shareholders of this company was held on Thursday last week at the Cannon Street Hotel, Mr. J. S. Forbes, the chairman, presiding.

In proposing the adoption of the report, the Chairman said he took the smallness of the meeting as an indication that the shareholders agreed with the directors in looking upon the report as a very satisfactory one. The income had increased by £89,815. The working expenses had naturally increased by £46,840. The net result left a profit balance of £240,043, being an increase of £33,155. The rents carried forward for unexpired terms amounted to the very large sum of £631,000, being an increase of £94,000. That was a really remarkable feature in the accounts that the character of the business should be such that in anticipation of periods beyond the particular half year they should have received those large sums of money paid in advance in respect of services to be rendered. There was a balance of £199,949 available for dividend, and out of that they proposed to pay 6 per cent. on the first and second preference shares, 5 per cent. on the third preference shares and 6 per cent. per annum, free of income-tax, on the ordinary shares, but of the surplus remaining the company proposed to transfer £80,000 to the general reserve fund, being £30,000 more than was transferred to that fund in the corresponding half year, and to carry forward £6,199. The Post Office royalties had increased by £8,919 The working expenses had fallen from 60·16 per cent. to 59·94 per cent. That was a very small reduction when taken at a £100, but a very important one when taken upon the large sums of money which they dealt with. The debenture and other interest had increased, which was due to the fact that between December, 1898, and December, 1899, they had issued a considerable amount of debenture stock, which, of course, came in for dividend. Taking 1899 as a whole, the year had been a record one for the company. They had made a much greater advance in that year than in any preceding year in the history of the company. They had achieved those results for a series of years in the face of many difficulties which were not known when the company started. But they had stuck to the company, and had carried the science to its present state—not of absolutely perfection, but of great utility, leaving much still to be desired, which would doubtless be achieved in the future. In the preliminary stages they were naturally involved in many failures, but they had persevered, and had taken positions which at first seemed to be hopeless, and if they only got fair play, as he believed they would, the service would be made still more efficient. He could not believe that they would not receive fair play, because if any pledges of Ministers and statesmen were specific and clear on the subject, the statements which they had in the course of their discussions with the Government were most specific promises. The anxiety of the Government, and particularly the head of the Post Office business, Mr. Hanbury, was that the company should be dealt with upon principles of scrupulous fairness, and he (Mr. Forbes) had no doubt that would be the case. In fact, he would be very much surprised, and so would the shareholders, if they were not. The Post Office royalties last year amounted to £64,176—21 per cent. on their net income, and he thought that was a monstrous tax. People who talked about exorbitant charges, &c., for the telephones, might perhaps take into account that they would be able to have their telephones very much less if the Government did not impose that heavy tax upon their income, as they knew the Post Office, with a perfect right, had determined that in London they were going to erect a service. They did not object, and he daresay, with the competition, the company would still manage to get along. Seeing the progress which the company had made in the last four or five years, they must be content to believe that they would go on expanding the business and making satisfactory profits. It was sometimes said that if the telephones were in anyone else's hands than in their company's the thing would have been done much better. Well, that pleased the people who said it, and it did not very much hurt the company. They often heard that Germany was a very great country with regard to the telephone service. His vocation took him to Germany sometimes, and he had been reading with must interest the revised

system which the Germans had employed to their telephone system, and he could hardly believe his eyes when he read such statements as the following in the German Parliament applying to the telephone: "Worst, most inefficient, most expensive, most abominable, &c." He thought at first that some mistake must have been made, and that he was reading a criticism in a London paper of the National Telephone Company. Most of the difficulties in connection with the telephones rose from the stupidity plus the selfishness of the user. When a man was using a telephone he thought the whole property was his, and did not think of the others who were waiting. No doubt the service was greatly improved, and that it was now becoming from day to day more indispensable, and to those who took the little trouble required to use it wisely, it was a most potent adjunct to men in business or social life. As showing the progress which they had made, he might say that in the year ending 1894 they had in round numbers 73,000 lines. They sprang in 1895 to 82,000, in 1896 to 94,000, in 1897 to 106,000, in 1898 to 150,000, and the past year had been a record year, showing that as between 1894 and 1899 they had increased by some 67,000 subscribers.

Lord HARRIS seconded the motion for the adoption of the report.

Replying to a question, the CHAIRMAN said that the reserve fund was not invested separately, and was used in the business. They could get much larger return upon the money in the business than if they deposited it or invested it in a bank.

The report was adopted, and the proceedings closed with a vote of thanks to the chairman.

## Chelsea Electricity Supply Company, Limited.

THE directors' report reads as follows:—"The directors beg to submit to the shareholders the report and statement of accounts for the year ended December 31st, 1899. In October, 1899, an issue of £50,000 debenture stock was made at the price of 107 per cent. The issue was fully paid up in January, and a Stock Exchange quotation has been granted. The balance of premium received in 1899, after deducting expenses of issue and certain special law and incidental expenses, has been carried, as on previous occasions, to the reserve fund. In consequence of the exceptionally high price of coal, the directors think it prudent to place a special amount of £1,096 8s. 5d. to reserve, as provision for the largely increased outlay under this head of expenditure, for the current year. The total of the reserve fund now stands at £48,604 13s. 8d. The sum of £3,000 has been added to the renewals and depreciation fund, out of the net revenue. After deducting this amount and the above-mentioned amount of £1,096 8s. 5d., and after payment of interest on debenture stock (£4,668 15s.), there remains a balance of £12,000. The directors recommend that this balance shall be applied as under:—

| | | | |
|---|---|---|---|
| Interim dividend of 6 per cent. per annum on the preference shares for the half-year to June 30th, 1899 (paid July 1st, 1899) .. .. .. .. .. .. .. .. | £900 | 0 | 0 |
| Interim dividend of 5 per cent. per annum on the ordinary shares for the half-year to June 30th, 1899 (paid July 1st, 1899) .. .. .. .. .. .. .. .. .. | 4,250 | 0 | |
| Dividend of 6 per cent. per annum on the preference shares for the half-year to December 31st, 1899 .. .. | 900 | 0 | 0 |
| Dividend of 7 per cent. per annum on the ordinary shares for the half-year to December 31st, 1899, making a total dividend of 6 per cent. for the year .. .. .. .. | 5,950 | 0 | 0 |
| | £12,000 | 0 | 0 |

The number of lamps connected on December 31st, 1899, was 128,867, an addition of 16,280 during the year. The directors have adopted what is known as the maximum demand system of charge for customers on the 200-volt supply. They believe that this change is appreciated and that it will benefit the company. The hire purchase system for wiring and fittings has also been introduced. The retiring directors, Mr. J. Irving Courtenay and Major-General C. E. Webber, C.B., are eligible for re-election. Mr. Emile Garcke, owing to the pressure of other engagements, has retired from the board. The auditors, Messrs. Cooper Brothers & Co., offer themselves for re-election."

## The Hove Electric Lighting Company, Limited.

THE directors' report to be presented at the meeting at Cannon Street Hotel on Wednesday, March 7th, reads:—

The directors beg to submit the statements of account and balance-sheet made up to December 31st, 1899. The electricity sold to consumers during the year amounted to 444,499 units compared with 350,354 units in 1898, while the gross revenue amounted to £12,070 5s. 8d., as against £9,480 7s. 1d. in the previous year, an increase of £2,589 18s. 7d. The gross expenditure reached £4,973 2s. 1d. against £4,390 8s. 11d. in 1898, an increase of £5^2 13s. 2d., the net result being a profit of £7,097 8s. 7d., compared with £5,089 18s. 2d. in the previous year, or an increase of £2,007 5s. 5d. The directors have again much pleasure in congratulating the shareholders on the successful working of their undertaking, a result due, in a great measure, to the reduction made in price in favour of the consumers in 1891. A further reduction in the prices charged has been made, under certain conditions, from January 1st in this year, which it is hoped will still further add to the profits of the company, and the directors propose to again make further reductions as the board see their way to meeting the increasing demand. The lamps and motors connected to the company's system on December 31st last, were equivalent to 44,824 8-C.P. lamps, and the number of houses connected 671, as compared with 36,967 lamps and 513 houses at the end of 1898. To the net revenue of £7,097 3s. 7d. there has to be added the sum of £376 0s. 7d. brought forward from the previous year, making a total of £7,478 4s. 2d. After deducting debenture interest paid and accrued, the interim dividend at the rate of 6 per cent. per annum paid in October last, and providing for income-tax, there remains a net balance of £5,030 14s. 3d. to the credit of net revenue account. The directors propose to write the sum of £262 5s. off preliminary expenses account, to place £2,000 to the credit of the reserve fund, to declare a dividend, payable on April 14th next, at the rate of 9 per cent. per annum for the half-year on the share capital, making with the interim dividend 7½ per cent. for the year, and to carry the balance of £614 17s. 10d. forward. With the addition now proposed to be made, the sum at credit to reserve fund will amount to £12,287 17., and with the sum of £155 14s. 3d. added to depreciation and maintenance reserve account, the balance under this head is increased to £1,261 7s. 4d. During the past year the directors have issued 2,000 additional shares at the price of £7 10s. each, the premium on the issues being added to the reserve fund. The expenditure on capital account during the year amounted to £16,210 2s. 7d. The generating station had been enlarged to the fullest extent which the Corporation of Hove will allow on the present site. Two additional steam dynamos of 350 and 250-H.P. respectively, and another Babcock & Wilcox boiler, have been placed in the generating station. A sum of £4,686 has been expended on new mains and in strengthening the existing feeders and mains, and £1,255 on additional meters and demand indicators. The total expenditure, to the close of the year amounted to £98,660 14s. 9d. The directors have ordered another 250-H.P. steam dynamo for delivery in the early autumn. This will completely fill up the space for machinery at the present station, and it is hoped, will meet the requirements for next winter. It is clear that the company must add largely to its generating power before the directors can reduce the charges to a point which it is anticipated will yield the very best results, and that the steady growth of the company's business fully justifies the erection of a second generating station the following figures will prove:—

| Year. | Houses. | 8-C.P. lamps. | Units sold. | Gross revenue. | Net revenue |
|---|---|---|---|---|---|
| 1896 .. | 314 .. | 21,756 .. | 200,562 .. | £6,518 .. | £3,114 |
| 1897 .. | 397 .. | 27,777 .. | 268,243 .. | 7,269 .. | 3,602 |
| 1898 .. | 513 .. | 36,967 .. | 350,254 .. | 9,480 .. | 5,089 |
| 1899 .. | 671 .. | 44,824 .. | 444,499 .. | 12,070 .. | 7,097 |

The directors have consequently been seeking for a fresh site for a second generating station, and they have found one in an exceptionally good position, on which they propose building as soon as the agreements, &c., are completed, and the necessary plans and estimates have prepared. The erection of this new station and its equipment with the generating plant, together with the connection of the station with the existing mains, will of course involve considerable capital expenditure, but the directors have every confidence that the outlay will prove as remunerative as that already incurred. In accordance with the articles of association Mr. Carleton F. Tufnell retires from the board of directors by rotation, but offers himself for re-election. The auditors also offer themselves for re-election.

## Northampton Electric Light and Power Company, Limited.

THE annual report of this company reads thus:—

In the last annual report the directors announced that they had determined to adhere to the policy of reducing the price of current, "whatever might be the immediate effect on profit and loss." The course taken has been fully justified by the result. During the past year the additional lamps fixed (at 8 C.P.), have been 5,667, and motive power supplied equivalent to 1,035 lamps; total, 6,702; as against 1,977 for the previous year. There is now the equivalent of 19,768 lamps fixed. The balance of the revenue account is £1,714 5s. 8d., as compared with £1,258 10s. 7d. In pursuance of the line of policy above indicated, the tariff for motive power has been reduced to ¼d. per unit for current used after a three hours' daily maximum demand. The acquisition of land referred to in the last report has now been carried into effect, with the result that the company is in possession of a large and compact freehold estate with three important frontages. The company's mains have been extended in various directions, 2¼ miles in all, making a total of 6 miles 18 yards. With regard to coal, the directors have been obliged to pay an increased price of 15 per cent., but as they entered into a new contract last autumn, it is hoped that the great rise which has taken place this year will not affect the company. It has been decided to raise the pressure of the company's supply, which will conduce to more economical working and a better service. The change to the higher pressure is now being almost universally adopted throughout the country. With reference to the application of the balance of revenue, it will be seen that a further sum of £850 has been carried to the depreciation account, making a total of £2,000, and that £43 has been written off preliminary expenses. Dividends on the preference shares will be paid for the year ending December 31st, 1899, viz., 6 per cent. fixed, £233, and 5 per cent. fixed, £261 11s. 8d. It is proposed to pay 2 per cent. on all the ordinary shares, which will require £368 17s. 9d., and to carry forward £178 13s. 6d. Messrs. S. L. Seckham and R. Cleaver retire from the board in rotation, and Mr. Cleaver only offers himself for re-election.

## The Oxford Electric Company, Limited.

THE directors' report to be submitted to the shareholders at to-day's meeting at Oxford reads as follows:—

The directors beg to submit their report and the accounts for the year ending December 31st, 1899. The revenue account shows a profit (including £85 3s. 5d. brought forward from last year) of £5,553 1s. 2d. After providing £1,741 11s. 2d. for debenture and other interest, writing off £184 19s. 11d. on account of hire purchase installations, and £53 0s. 1d. from office furniture account, the available balance is £3,578 10s., which your directors propose to appropriate as follows:—£2,500 in payment of a dividend at the rate of 5 per cent. per annum on the share capital, and £1,000 to be added to the reserve and renewal of plant account (which will then amount to £1,750), leaving £73 10s. to be carried forward to next year's accounts. Since the last report 3,638 8-C.P. lamps (or their equivalent) have been connected to the mains. This increase compares favourably with the average progress in previous years. The hire purchase system of installing the light continues to give satisfactory results. To meet the increased demand for current a sub-station has been established at New College, and an additional transformer installed in Ship Street. The distributing mains of the company have been extended in the South Parks, Cradmore, Norham, Woodstock, Chalfont, and Frenchay Roads. The whole plant has been maintained in efficient order. Mr. J. W. Barclay and Mr. J. Irving Courtenay retire from the board by rotation, and are eligible for re-election. The auditor, Mr. W. S. Carver, offers himself for re-election.

## The Newcastle-upon-Tyne Electric Supply Company, Limited.

THE annual meeting of this company was held last Friday at Newcastle, Alderman T. G. Gibson presiding.

The CHAIRMAN, in moving the adoption of the report, dealt in the first place with the capital expenditure. During the year this had amounted to £28,500. The principal items of expenditure were on land (of which the company had now nearly two acres at Pandon Dene), buildings, generating and street plant, including the part cost of establishing a continuous current service, which was exceedingly necessary, and promised good results. The total length of mains laid was now 26 miles, of which five miles had been added during the year. The profit for the year, including the balance brought forward, was £7,495, as against £6,020 in 1898. The mortgage debentures, amounting to £25,000, fell due, and were paid off on September 1st last, and nearly 6,000 new shares had been issued at a premium of £2 per share. These premiums had been carried to reserve account,

which now stood at £20,000. He moved that a dividend of 4 per cent. be declared, making with the interim dividend 8 per cent. for the year.

The motion was carried unanimously.

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At an extraordinary meeting subsequently held, a resolution was passed increasing the capital by the creation of £200,000 additional capital.

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**Alliance Electrical Company, Limited.**—The report for the 12 months ended January 31st states that the accounts, after deducting directors' fees and making provision for depreciation and for bad and doubtful debts, show a net profit of £9,648. The directors propose, after applying £666 towards the expenses of the company's formation and £100 to the profit-sharing scheme, to declare a dividend of 10 per cent. on the ordinary shares, carrying forward £864.

**Stock Exchange Notices.**—Applications have been made to the Stock Exchange Committee (1) to appoint a special settling day in and to grant a quotation to:—British Aluminium Company, Limited—5 per cent. first mortgage debenture stock, and (2) to appoint a special settling day in British Aluminium Company, Limited—15 000 7 per cent. cumulative preference shares of £10 each, fully paid, Nos. 1 to 15,000.

**The Western Telegraph Company, Limited.**—The directors have declared an interim dividend of 3s. per share, or at the rate of 6 per cent. per annum, free of income tax, for the quarter ended December 31st, 1899, and payable on March 23rd. The transfer books will be closed from March 16th to March 22nd, both days inclusive.

**Metropolitan Electric Supply, Limited.**—The board recommends a further and final dividend of 5s. per share, making a total distribution of 5 per cent. for the past year.

**Norwich Electric Tramways Company.**—On Tuesday last a meeting of this company was held at 4, Bank Buildings, E.C., but the proceedings were not open to the press.

**British Electric Traction Company.**—Letters of allotment in respect of the issue of £150,000 5 per cent. perpetual debenture stock have been posted.

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## TRAFFIC RECEIPTS.

**Blackpool and Fleetwood Tramroad Company.**—The receipts for the week ending February 24th, 1900, were £143 5s. 7d.; receipts for corresponding period, 1899, £207 4s. 3d.; aggregate for half-year to date, £1,112 13s. 6d.

**The Bristol Tramways and Carriage Company, Limited.**—The receipts for the week ending February 28rd, 1900, were £2,648 16s. 2d.; corresponding period, 1899, £2,589 17s. 8d.; increase, £58 18s. 6d.

**The City and South London Railway Company.**—The receipts for the week ending February 25th, 1900 were £1,115; ditto February 19th, 1899, £1,102; increase, £13. Total receipts for half-year, 1900, to date, £9,014; corresponding period, 1899, £8,960; increase £54. Miles open, 8½.

**The Dover Corporation Tramways.**—The receipts for the week ending February 24th, 1900, were £141 5s. 8d.; February 25th, 1899, £142 9s. 1d.; decrease, £1 3s. 5d. Total receipts to date, 1900, £1,170 0s. 10d.; corresponding period, 1899, £1,143 3s. 5d.; increase, £26 17s. 5d. Miles of track open, 1900, 3; 1899, 3. Car miles run, 1900, 4,866; 1899, 4,813. Number of cars, 1900, 11; 1899, 11.

**The Dublin United Tramways Company.**—The receipts for the week ending Friday, February 23rd, 1900, were as follows:—D. U. T. Co., horse cars, £50 19s. 8d.; ditto, electric cars, £2,880 7s. 6d.; D. S. D. Co., electric cars, £613 5s. 1d.; total, £3 544 12s. 3d.; corresponding week last year—D. U. T. Co., horse cars, £1,920 18s. 10d.; ditto, electric cars, £760 8s. 6d.; D. S. D. Co., electric cars, £655 8s. 4d.; total, £3,336 15s. 8d.; increase, £207 16s. 7d. Aggregate to date, £26,619 12s. 9d.; aggregate to date last year, £24,883 7s. 11d.; increase to date, £1,736 4s. 10d. The mileage worked is 42 miles electrically, 2 miles by horses, as against 18 miles electrically, 26 miles by horses, for the corresponding period last year.

**The Halifax Corporation Tramways.**—The receipts for the week ending February 25th, 1900, were £560; week ending March 1st, 1899, £302; increase, £258. Number of cars, 1900, 28; 1899, 15. Total receipts to date, 1900, £27,487; 1899, £9,428. Miles of track open, 1900, 12; 1899, 6¼.

**The Liverpool Overhead Railway Company.**—The receipts for the week ending February 25th, 1900 amounted to £1,360: corresponding week last year, £1,280; increase, £80. Total increase in traffics for half-year to date, £1,167.

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## STOCKS AND SHARES.

Wednesday Evening.

The surrender of Cronje and capture of 4,000 prisoners by Lord Roberts gave rise to great enthusiasm within the Stock Exchange, and the general cheerfulness became imparted to prices in a small degree. At the close of business on Tuesday, however, there were many Stock Exchange members expressing disappointment at the insignificance of the rises which remained after the day's work. It was thought that such an event would have been signalised by a great accession of public business in all departments, but this is exactly what did not happen, not even the mining markets receiving any outside support worth mentioning. Brokers and dealers consoled themselves, however, with the reflection that what was really wanted to revive business was the relief of Ladysmith, and until that happened, they agreed that the public would not take a hand freely either in investment or speculative departments. The flatness of Consols, induced by the disclosure of an unexpected bull account at the settlement on Tuesday, militated against a rise in the more steady-going stocks and shares such as those with which we deal, nor were the favourable dividends and reports of the supply companies sufficient to create any demand for the shares.

The Chelsea Electricity Supply and the Metropolitan Electric Supply Companies have both declared dividends at the same rate as this time last year, and the price of the Ordinary shares remain unaltered. Each of these undertakings has done well during 1899, and could have paid at a higher rate, but the directors prudently consider that the needs of strengthening their companies' position are too great to admit of an enhanced dividend. In the Chelsea report, for instance, the directors state that in consequence of the exceptionally high price of coal, they have placed a special amount of £1,096 to reserve, as provision for the largely increased outlay under this head of expenditure, for the current year. The Metropolitan Electric Board do well to adopt a conservative policy, considering how they are threatened with competition and a long period of unsettlement. A member of the Marylebone Vestry told us the other day that the negotiations between that body and the Metropolitan Electric Company would probably go on for months before any definite arrangements were arrived at.

The City of London dividend has been declared at the rate of 4 per cent. per annum, which is in accordance with our recent forecast. The price has hardened a trifle. Westminsters and "Jimmies" are both quoted *ex* dividend, the shares of the latter quickly recovering the amount deducted. Westminsters, however, are quiet, and are likely to remain so until the new capital issue is made, of which we wrote last week. At the price now ruling the yield is exactly 4 per cent., which is not particularly attractive in the present condition of the investment-stock market. St. James's return £4 10s. 6d., and Chelseas 1 per cent. less than this at the present quotations.

The National Telephone Company's meeting revealed nothing fresh. Mr. J. S. Forbes, the chairman, naturally extolled the company's working, and drew comparisons between the National and various Continental companies that were very favourable to the former. Perhaps Mr. Forbes never uses a telephone. The price of the Ordinary shares, allowing for the dividend, is practically unaltered, but the first and second Preferences have recovered the distribution and remain at 14½ *ex* dividend.

British Electric Traction shares are an extremely hard market, and a large amount of business is doing in them. This is mainly due to the company's activity in the direction of electrical tramway extension all over the country, to which we have frequently called attention of late. It must be distinctly amusing to shareholders in this undertaking to read the account of a meeting of tramway proprietors in a northern county when the chairman loudly lamented the decreased profits made on his company's system (horse-hauled), owing to the spread of electric traction all round the neighbourhood. A fair amount of business has sprung up in British Columbia Electric 5 per cent. Preference, and the £10 fully paid shares are standing at 10⅝. Potteries Electric Traction keep steady at 12.

In the Stock Exchange the rebuff suffered by the County of London and Brush Provincial Company is regarded as of little moment by the "shop," but we are inclined to take a more serious view of it.

Telegraph stocks are steadily quiet, without one feature of particular interest. The Anglo group has simmered down into something approaching neglect, and all the speculation in the miscellaneous market is now transferred to gun shares, notably Vickers. The Eastern issues maintain their prices, and almost the only change in this department is an advance of a point in London Platino-Brazilian 6 per cent. Debentures. Western Union Telegraph 6 per cent. sterling bonds, which mature on March 1st, are now repayable at par, and should be sent to the company's office at 6, Princes Street, E.C.

Decidedly interesting figures came out the other day in the Law Courts about the London Electric Omnibus Company, which sued a shareholder for non-payment of calls. The defendant alleged misrepresentations in the prospectus. It was stated that all the directors implicitly believed the statements which were made therein, and they had taken no fees since November, 1896. The company's money went in payment of the promoters and in making experiments, but Major Flood Page said he thought that in all three omnibuses had been manufactured. It is hardly a matter for astonishment that the shares should be unsaleable in the Stock Exchange.

## SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

| Present Issue. | NAME. | Stock or Share. ‡ | Dividends for the last three years. 1897. | 1898. | 1899. | Closing Quotation, Feb. 21st. | Closing Quotation, Feb. 28th. | Business done during week ended Feb. 28th, 1900. Highest. | Lowest. |
|---|---|---|---|---|---|---|---|---|---|
| 110,900 | African Direct Telegraph, 4 % Debs. ... ... ... | 100 | ... | ... | ... | 99 —103 | 99 —103 | ... | ... |
| 25,000 | Amazon Telegraph, shares ... ... ... ... ... | 10 | ... | ... | ... | 3 — 4 | 3 — 4 | ... | ... |
| 125,000 | Do. do. 5 % Debs., Nos. 1 to 1,250 Red. | 100 | ... | ... | ... | 85 — 90 | 85 — 90 | ... | ... |
| 875,520 | Anglo-American Telegraph ... ... ... ... ... | Stock | 3 % | £3 9s | 73/6 | 63 — 66 | 63 — 66 | 63½ | ... |
| 3,062,240 | Do. do. 6 % Pref. ... ... ... | Stock | 6 % | 6 % | 6 % | 114 —115 | 114½—115½ | 115 | 114½ |
| 3,062,240 | Do. do. Deferred... ... ... ... | Stock | ... | 18s. % | £1 7s | 14½— 15 | 14⅝— 15½ | 14 15/16 | 14⅜ |
| 44,000 | Chili Telephone, Nos. 1 to 44,000 ... ... ... ... | 5 | 4 % | ... | ... | 2 — 3 | 2 — 3 | ... | ... |
| 10,000,000$ | Commercial Cable ... ... ... ... ... ... | $100 | 8 % | 8 % | ... | 165 —175 | 165 —175 | ... | ... |
| 1,332,823£ | Do. do. Sterling 500 year 4 % Deb. Stock Red. | Stock | ... | ... | ... | 103 —106 | 103 —105 | 104½ | ... |
| 224,850 | Consolidated Telephone Construction and Manufacturing | 10/- | 1½ % | 1 % | ... | ⅛— ¼ | ⅛— ¼ | ... | ... |
| 16,000 | Cuba Telegraph ... ... ... ... ... ... ... | 10 | 7 % | 8 % | ... | 9 — 10 | 9 — 10 | ... | ... |
| 6,000 | Do. 10 % Pref. ... ... ... ... ... | 10 | 10 % | 10 % | ... | 19 — 20 | 19 — 20 | ... | ... |
| 12,931 | Direct Spanish Telegraph ... ... ... ... | 5 | 4 % | ... | ... | 4 — 5 | 4 — 5 | ... | ... |
| 6,000 | Do. do. 10 % Cum. Pref. ... ... | 5 | 10 % | ... | ... | 9 — 10 | 9 — 10 | ... | ... |
| 30,000 | Do. do. 4½ % Debs. ... ... ... | 50 | ... | ... | ... | 101 —105% | 101—105% | ... | ... |
| 60,710£ | Direct United States Cable ... ... ... ... | 20 | 3½ % | 3½ % | 3 % | 11½— 12 | 11½— 12 | 11⅞ | ... |
| 120,000 | Direct West India Cable, 4½ % Reg. Deb. ... ... ... | 100 | ... | ... | ... | 99 —102 | 99 —102 | ... | ... |
| 4,000,000 | Eastern Telegraph, Ord. Stock ... ... ... ... | Stock | 7 % | 7 % | ... | 155 —160 | 155 —160 | 158½ | 156 |
| 1,795,000 | Do. 3½ % Pref. Stock ... ... ... | 100 | ... | ... | ... | 98 —101 | 98 —101 | 100 | 98½ |
| 1,432,268£ | Do. 4 % Mort. Deb. Stock Red. ... ... | Stock | 4 % | ... | ... | 116 —121 | 116 —121 | ... | ... |
| 250,000 | Eastern Extension, Australasia, and China Telegraph ... | 10 | 7 % | 7 % | ... | 15½— 16 | 15½— 16 | 16 | 15½ |
| 16,200£ | Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326 | 100 | 5 % | ... | ... | 100 —103 | 100 —103 | ... | ... |
| 64,400£ | Do. do. Bearer, 1,050—3,975, 4,327—6,400 | 100 | 5 % | ... | ... | 100 —103 | 100 —103 | ... | ... |
| 320,000£ | Do. 4 % Deb. Stock ... ... ... ... ... | Stock | 4 % | ... | ... | 115 —120 | 115 —120 | 116 | ... |
| 800,000£ | Eastern and South African Telegraph, 4 % Mort. Deb., Nos. 1 to 3,000, red. 1909 | 100 | ... | ... | ... | 100 —103 | 100 —103 | ... | ... |
| 200,000£ | Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—3,000 | 25 | ... | ... | ... | 101 —104% | 101 —104% | ... | ... |
| 180,227 | Globe Telegraph and Trust ... ... ... ... ... | 10 | 4½ % | 5½ % | ... | 11¼— 11½ | 11¼— 11½ | 11⅝ | 11⅝ |
| 180,042 | Do. do. 6 % Pref. ... ... ... | 10 | 6 % | 6 % | ... | 15½— 16 | 15½— 16 | 15⅝ | ... |
| 150,000 | Great Northern Telegraph, of Copenhagen... ... ... | 10 | 10 % | ... | ... | 31 — 33 | 31 — 33 | 32¼ | ... |
| 86,300 | Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red. | 100 | ... | ... | ... | 99 —102 | 99 —102 | ... | ... |
| 17,000 | Indo-European Telegraph ... ... ... ... ... | 25 | 10 % | 10 % | ... | 49 — 53 | 49 — 53 | ... | ... |
| 100,000£ | London Platino-Brazilian Telegraph, 6 % Debs. ... ... | 100 | 6 % | ... | ... | 106 —109 | 107 —110 | ... | ... |
| 72,680 | Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ... | 1 | ... | ... | ... | ¼— ½ | ¼— ½ | ... | ... |
| 86,492 | Do. do. 5% Pref., Nos. 1 to 86,492 | 1 | 4 % | 4 % | 2½ % | ¾— 1 | ¾— 1 | ... | ... |
| 490,000 | National Telephone, 1 to 490,000 ... ... ... ... | 5 | 6 % | 6 % | 5 % | 5¼— 5½ | 5⅛—5⅜xd | 5 5/16 | 5⅛ |
| 15,000 | Do. 6 % Cum. 1st Pref. ... ... ... | 10 | 6 % | 6 % | 6 % | 14 — 15 | 14 — 15 xd | ... | ... |
| 15,000 | Do. 6 % Cum. 2nd Pref. ... ... ... | 10 | 6 % | 6 % | 6 % | 14 — 15 | 14 — 15 xd | 14⅜ | ... |
| 250,000 | Do. 5 % Non-cum. 3rd Pref., 1 to 250,000 | 5 | 5 % | 5 % | 6 % | 5⅜— 5⅝ | 5¼— 5½xd | 5 7/16 | 5⅜ |
| 1,329,471£ | Do. 3½ % Deb. Stock Red. ... ... | Stock | 3½ % | 3½ % | 3½ % | 97 —100 | 97 —100 | 99 | 97½ |
| 171,504 | Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid | 1 | 5 % | 5 % | ... | ¾— 1 | ¾— 1 | ... | ... |
| 100,000£ | Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ... | 100 | 4 % | ... | ... | 101 —104 | 101 —104 | ... | ... |
| 11,839 | Reuter's ... ... ... ... ... ... ... | 8 | 5 % | ... | ... | 7 — 8 | 7 — 8 | 8¼ | 8 3/16 |
| 3,381 | Submarine Cables Trust ... ... ... ... ... | Cert. | ... | ... | ... | 124 —129 | 124 —129 | 125 | ... |
| 58,000 | United River Plate Telephone ... ... ... ... | 5 | 5 % | 6 % | 6 % | 4¾— 5¼ | 4¾— 5¼ | ... | ... |
| 16,639 | Do. do. 5 % Cum. Pref. Nos. 1—16,639 | 5 | ... | ... | ... | 4¾— 5¼ | 4¾— 5¼ | ... | ... |
| 179,947 | Do. do. 5 % Debs. ... ... ... | Stock | ... | ... | ... | 103 —106 | 103 —106 | ... | ... |
| 200,000£ | West African Telegraph, 5 % Debs. ... ... ... ... | 100 | % | ... | ... | 98 —101 | 98 —101 | ... | ... |
| 80,008 | West Coast of America, Nos. 1—80,000 and 53,001—53,008 | 2½ | ... | ... | ... | ¾— 1 | ¾— 1 | ... | ... |
| 150,000 | Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel. | 100 | ... | ... | ... | 100 —103 | 100 —103 | ... | ... |
| 389,731 | Western and Brazilian Telegraph 4 % Deb. Stock Red. ... | Stock | ... | ... | ... | 100 —104 | 100 —104 | ... | ... |
| 205,993 | Western Telegraph, Ltd., Nos. 1—205,993 ... ... ... | 10 | ... | ... | ... | 14¾— 15½ | 14¾— 15½ | 15½ | 15 |
| 75,000 | Do. do. 5 % Debs. 2nd series, 1906 ... | 100 | ... | ... | ... | 106 —109 | 106 —109 | ... | ... |
| 88,321 | West India and Panama Telegraph ... ... ... ... | 10 | ⅜ % | ... | ... | ⅞— 1⅛ | ⅞— 1⅛ | 1 1/16 | ... |
| 34,568 | Do. do. do. 6 % Cum. 1st Pref. ... | 10 | 6 % | ... | ... | 9¼— 9¾ | 9¼— 9¾ | ... | ... |
| 4,669 | Do. do. do. 6 % Cum. 2nd Pref. ... | 10 | 6 % | ... | ... | 7 — 8 | 7 — 8 | ... | ... |
| 80,000£ | Do. do. do. 5 % Debs., Nos. 1 to 1,800 | 100 | 5 % | ... | ... | 104 —107 | 104 —107 | ... | ... |
| 158,100£ | Western Union of U.S. Telegraph, 6 % Ster. Bonds ... | 100 | 6 % | ... | ... | 98 —103 | 98 —103 | ... | ... |

## ELECTRICITY SUPPLY COMPANIES.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 19,661 | Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761 | 5 | 4 % | 6 % | ... | 7 — 8 | 7 — 8 | ... | ... |
| 12,000 | Do. do. 7 % Cum. Pref. ... | 5 | 7 % | ... | ... | 8½— 9½ | 8½— 9½ | ... | ... |
| 80,000 | Charing Cross and Strand Electricity Supply ... ... | 5 | 7 % | 8 % | 9 % | 10 — 11 | 10 — 11 | 10⅜ | ... |
| 20,000 | Do. do. do. do. Nos. 30,001—50,000 | 5 | ... | ... | ... | 10 — 11 | 9½— 10½ | ... | ... |
| 20,000 | Do. do. do. do. 4½ % Cum. Pref. | 5 | ... | ... | ... | 5¾— 6¼ | 5¾— 6 xd | ... | ... |
| 34,000 | *Chelsea Electricity Supply, Ord., ... ... ... ... | 5 | 6 % | 6 % | 6 % | 7⅞— 8⅛ | 7¼— 8¼ | 7 1/16 | ... |
| 100,000 | Do. do. do. % Deb. Stock Red.... | Stock | 4½ % | ... | ... | 110 —112 | 110 —112 | ... | ... |
| 60,000 | City of London Electric Lighting, Ord. 40,001—100,000 ... | 10 | 10 % | 6 % | 4 % | 10½— 11½ | 10 — 11 | 10⅜ | ... |
| 40,000 | Do. 6 % Cum. Pref., 1 to 40,000 ... ... ... | 10 | 6 % | 6 % | ... | 13 — 14 | 13 — 14 | 13⅞ | 13⅜ |
| 400,000 | Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid | ... | 5 % | ... | ... | 122 —127 | 122 —127 | ... | ... |
| 40,000 | County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000 | 10 | nil | nil | ... | 9½— 10½ | 9½— 10½ | 10 | 9 1/16 |
| 20,000 | Do. do. do. 6 % Pref., 40,001—60,000 | 10 | 6 % | 6 % | ... | 12½— 13½ | 12½— 13½ | ... | ... |
| 200,000 | Do. 4½% Deb. Stock, Prov. Certs (all paid) Rd. ... | ... | ... | ... | ... | 109 — 112 | 109 —112 | ... | ... |
| 26,100 | Edmundsons Elec. Corp., Ord. Shares ... ... ... | 5 | 5 % | 7 % | ... | 4¾— 5¼ | 4¾— 5¼ | ... | ... |
| 110,000 | London Electric Supply Corporation, Limited, Ord. ... | 3 | ... | ... | ... | 1¾— 2¼ | 1¾— 2¼ | ... | ... |
| 48,050 | Do. do. do. 6 % Pref. | 5 | ... | 6 % | ... | 4½— 5 | 4½— 5 | ... | ... |
| 100,000 | Do. do. do. 4% 1st Mt. Db. Stock Rd. | Stock | ... | ... | ... | 101 —103 | 101 —103 | ... | ... |
| 62,500 | Metropolitan Electric Supply, 101 to 62,500 ... ... | 10 | 6 % | 5 % | 5 % | 14 — 15 | 14 — 15 | 14 5/16 | 14¼ |
| 22,500 | Do. Nos. 62,501 to 85,000 ... ... ... | 10 | ... | ... | ... | 14 — 15 | 14 — 15 | ... | ... |
| 220,000£ | Do. 4½ % First Mortgage Debenture Stock | ... | 4½% | ... | ... | 114 —117 | 114 —117 | ... | ... |
| 125,000 | Do. 3½ % Mort. Deb. Stock Red. ... ... | Stock | ... | ... | ... | 95 — 97 | 95 — 97 | ... | ... |
| 6,452 | Notting Hill Electric Lighting ... ... ... ... | 10 | 6 % | 6 % | 7 % | 16 — 17 | 16 — 17 | ... | ... |
| 31,980 | St. James's and Pall Mall Electric Light, Ord. ... ... | 5 | 14½ % | 14½ % | 14½ % | 15 — 16 | 15 — 16 | 15⅝ | 15 |
| 20,000 | Do. ..... do. 7 % Pref., 20,081 to 40,080 | 5 | 7 % | 7 % | 7 % | 9 — 9½ | 8½— 9½xd | ... | ... |
| 65,000 | South London Electricity Supply, Ord. ... ... ... | 5 | ... | ... | ... | 4 — 4½ | 4 — 4½ | 4½ | 4 |
| 79,900 | Westminster Electric Supply, Ord., 101 to 80,000 ... | 5 | 12 % | 12 % | 13 % | 14 — 15 | 13½— 14½xd | 14½ | 14 |

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid. ‡ Dividends paid in deferred share warrants, profits being used as capital
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next,

## SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

### ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

| Present Issue. | NAME. | Stock or Share. | Dividends for the last three years. 1897. | 1898. | 1899. | Closing Quotation Feb. 21st. | Closing Quotation Feb. 28th. | Business done week ended Feb. 28th, 1900. Highest. | Lowest |
|---|---|---|---|---|---|---|---|---|---|
| | | ‡ | | | | | | | |
| 65,000 | Aluminium shares, Nos. 1—65,000 ... ... ... ... | 1 | 10 % | ... | ... | 2⅜— 3¼ | 2⅜— 3¼ | 3 1/16 | ... |
| 90,000 | Do. 4½ % 1st Mort. Deb. Stock Red. ... ... | Stock | ... | ... | ... | 95 —100 | 97 —102 | ... | ... |
| 30,000 | British Electric Traction ... ... ... ... ... | 10 | ... | 6 % | ... | 16 — 17 | 16½— 17⅛ | 17⅜ | 17 |
| 30,000 | Do. do. 6 % Cum. Pref. 30,001—60,000 | 10 | ... | ... | ... | 13¼— 13⅜ | 13¼— 13⅜ | 13½ | 13 5/16 |
| 200,000 | Do. do. 5 % Perpetual Debenture Stock ... | Stock | ... | ... | ... | 125 —128 | 125 —128 | ... | ... |
| 45,000£ | †British Electric Works Co., Ord. £1 shares, 50,001—95,000 | ... | ... | ... | ... | 1 5/16— 1 1/16 | 1 5/16— 1 1/16 | ... | ... |
| 50,000 | † Do. do. 6 % Cum. Pref., 1—50,000 ... | ... | ... | ... | ... | ⅞— 1 | ⅞— 1 | ... | ... |
| 500 | † Do. do. 4½ % 1st Mort. Deb. ... ... | 100 | ... | ... | ... | 99 —101 | 99 —101 | ... | ... |
| 40,000 | British Insulated Wire Ord., Nos. 1 to 40,000 ... ... | 5 | ... | ... | 20 % | 13 — 14 | 12 — 13 | ... | ... |
| 27,500 | Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ... | 5 | ... | ... | ... | 6 — 6½ | 6 — 6½ | ... | ... |
| 90,000 | Brush Elecl. Enging., Ord., 1 to 90,000 ... ... ... | 3 | 3 % | 5 % | ... | 1⅝— 2 | 1⅞— 2⅛ | ... | ... |
| 90,000 | Do. do. Non-cum. 6 % Pref., 1 to 90,000 | 2 | 6 % | 6 % | ... | 2⅛— 2⅜ | 2⅛— 2⅜ | 2⅜ | ... |
| 125,000£ | Do. do. 4½ % Perp. Deb. Stock ... | Stock | ... | ... | ... | 110 —115 | 108 —113 xd | ... | ... |
| 50,000 | Do. do. 4½ % 2nd Deb. Stock Red. ... | Stock | ... | ... | ... | 102 —105 | 102 —105 | ... | ... |
| 30,000 | Callender's Cable Construction shares, Nos. 1—20,000 ... | 5 | 12½ % | 15 % | ... | 14 — 15 | 14 — 15 | ... | ... |
| 20,000 | Do. do. 5 % Cum. Pref. .. ... ... | 5 | ... | ... | ... | 5½— 6 | 5½— 6 | 5 11/16 | ... |
| 90,000 | Do. do. 4½ % 1st Mort. Deb. Stock Red. | Stock | ... | ... | ... | 110 —115 | 111 —115 | ... | ... |
| 213,533 | Central London Railway, Ord. Shares ... ... ... | 10 | ... | ... | ... | 9½— 10 | 9½— 10 | 9 11/16 | 9⅞ |
| 61,033 | Do. do. Pref. half-shares ... ... | 5 | ... | ... | ... | 4½— 5 | 4½— 5 | ... | ... |
| 71,447 | Do. do. Def. do. ... ... ... | 5 | ... | ... | ... | 4½— 5 | 4½— 5 | 5 | ... |
| 855,000 | City and South London Railway ... ... ... ... | Stock | 1⅛ % | 2⅛ % | 1⅞ % | 58 — 61 | 59 — 62 | 62 | 59½ |
| 37,000 | Do. do. Ord. shares, Nos. 22,501 to 60,000 £5 10s. pd. | 10 | ... | ... | ... | 4 — 5 | 4 — 5 | ... | ... |
| 32,098 | Crompton & Co., Nos. 1 to 32,098 ... ... ... ... | 3 | ... | ... | ... | 3½— 4 | 3½— 4 | 4 | ... |
| 100,000 | Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red. | ... | ... | ... | ... | 98 101 | 98 —101 | ... | ... |
| 99,261 | Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261 | 5 | 6 % | 6 % | ... | 2 — 2¼ | 2 — 2¼xd | ... | ... |
| 17,139 | Do. do. do. "A" Shares, 01—017,139 | 5 | 6 % | 6 % | ... | 3½— 4½ | 3½— 4½xd | ... | ... |
| 344,023 | Do. do. do. 4 % Deb. Stock Red. ... | 100 | ... | ... | ... | 93 — 95 | 93 — 95 | ... | ... |
| 112,100 | Electric Construction, 1 to 112,100 ... ... ... ... | 2 | 6 % | 6 % | ... | 2¼— 2½ | 2⅜— 2⅝ | ... | ... |
| 25,000 | Do. do. 7 % Cum. Pref., 1 to 25,000 ... | 2 | 7 % | 7 % | ... | 2¾— 3¼ | 2⅞— 3¼ | 3⅛ | ... |
| 140,800 | Do. do. 4% Perp. 1st Mort. Deb. Stock ... | Stock | ... | ... | ... | 103 —106 | 104 —107 | ... | ... |
| 91,196 | Elmore's Patent Copper Depositing, 1 to 70,000 ... ... | 2 | ... | ... | ... | ⅜— ⅝ | ⅜— ⅝ | ... | ... |
| 9,600£ | Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ... | 10 | 7 % | 7 % | ... | 10 — 12 | 10 — 12 | ... | ... |
| 30,000 | Henley's (W. T.) Telegraph Works, Ord. ... ... ... | 5 | 12 % | 14 % | ... | 14 — 15 | 14 — 15 | 14 7/16 | ... |
| 12,000 | Do. do. do. 4½ % Pref. ... ... | 5 | 7 % | 7 % | ... | 5½— 6 | 5½— 6 | ... | ... |
| 50,000 | Do. do. do. 4½ Mort. Deb. Stock... | Stock | 4½ % | ... | ... | 111 —114 | 110 —114 xd | ... | ... |
| 50,000 | India-Rubber, Gutta-Percha and Telegraph Works ... | 10 | 10 % | 10 % | ... | 21 — 22 | 21 — 22 | 21¾ | 21¼ |
| 800,000 | Do. do. do. 4 % 1st Mort. Debs. | 100 | ... | ... | ... | 100 —104 | 100 —104 | ... | ... |
| 37,500 | †Liverpool Overhead Railway, Ord. ... ... ... ... | 10 | 3¼ % | 3½ % | 3¾ % | 9½— 9⅝ | 9½ — 9⅝ | ... | ... |
| 10,000 | † Do. do. Pref., £10 paid ... ... | 10 | 5 % | 5 % | 5 % | 12¾— 13½ | 12½ — 13 | ... | ... |
| 37,350 | Telegraph Construction and Maintenance ... ... ... | 12 | 15 % | 15 % | 15 % | 37 — 41 | 37 — 41 | 38½ | ... |
| 150,000 | Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ... | 100 | ... | ... | ... | 102 —105 | 102 —105 | 102½ | ... |
| 20,000 | Telegraph Manufacturing, Ord. Nos. 1 to 20,000 ... | 5 | ... | ... | ... | 9 — 10 | 9 — 10 | ... | ... |
| 20,000 | Do. do. 5% Cm. Prf. Nos. 1 to 20,000 ... | 5 | ... | ... | ... | 5½— 6 | 5½— 6 | ... | ... |
| 540,000£ | Waterloo and City Railway, Ord. Stock ... ... ... | 100 | ... | 3 % | 3 % | 101 —104 | 101 —104 | 103 | 102½ |

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

### LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
Brompton and Kensington, 4½ % Debentures of £100, 104—107.
National Electric Free Wiring, 12/6 paid. ½—¾.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 17—19.
Do. do. Pref. (£10 pd.), 10—11.
Smithfield Market Electric, 2—3.

* From Birmingham Share List.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6 %, £5 (fully paid), 7½—8. Debentures, 103—106. Dividend, 1899, on Ordinary Shares 11 %.
Kidderminster and District Electric, Pref. (£6 pd.), 6—6½.
*T. Parker, £10 (fully paid), 18½.

**Bank rate of discount 4 per cent. (January 25th, 1900).**

## MARKET QUOTATIONS, Wednesday, February 28th.

| CHEMICALS, &c. | This week. | Last week. | Inc. or Dec. |
|---|---|---|---|
| a Acid, Hydrochloric .. .. per cwt. | 5/- | 5/- | .. |
| a „ Nitric .. .. .. per cwt. | 22/- | 22/- | .. |
| a „ Oxalic .. .. .. per cwt. | 32/- | 32/- | .. |
| a „ Sulphuric .. .. .. per cwt. | 5/6 | 5/6 | .. |
| a Ammoniac, Sal .. .. .. per cwt. | 40/- | 40/- | .. |
| a Ammonia, Muriate (crystal) .. per ton | £29 | £29 | .. |
| a „ „ .. .. per ton | £27 | £27 | .. |
| a Bleaching powder .. .. per ton | £7 | £7 | .. |
| a Bisulphide of Carbon .. .. per ton | £15 | £15 | .. |
| a Borax .. .. .. per ton | £16 10 | £16 10 | .. |
| a Benzole (90 %) .. .. .. per gal. | 7/- | 7/- | .. |
| a „ (50/90 %) .. .. per gal. | 5/6 | 5/6 | .. |
| a Copper Sulphate .. .. .. per ton | £25 | £25 | .. |
| a Lead, Nitrate .. .. .. per ton | £25 | £25 | .. |
| a „ White Sugar .. .. .. per ton | £31 | £31 | .. |
| a „ Peroxide .. .. .. per ton | £27 10 | £27 10 | .. |
| a Methylated Spirit .. .. per gal. | 2/9 | 2/9 | .. |
| a Naphtha, Solvent (90 % at 160° C.) .. .. .. .. per gal. | 5/6 | 5/6 | .. |
| a Potash, Bichromate, in casks.. per lb. | 5d. | 4¾d. | ¼d. inc. |
| a „ Caustic (75/80 %) .. per ton | £24 | £24 | .. |
| a „ Bisulphate .. .. per ton | £35 | £35 | .. |
| a Shellac .. .. .. .. per cwt. | 68/- | 68/- | .. |
| a Sulphate of Magnesia .. .. per ton | £4 10 | £4 10 | .. |
| a Sulphur, Sublimed Flowers .. per ton | £6 | £6 | .. |
| a „ Recovered .. .. per ton | £5 10 | £5 10 | .. |
| a „ Lump .. .. .. per ton | £5 | £5 | .. |
| a Soda, Caustic (white 70 %) .. per ton | £10 15 | £10 15 | .. |
| a „ Crystals .. .. .. per ton | £3 | £3 | .. |
| a „ Bichromate, casks .. per lb. | 4¼d. | 5¼d. | ¼d inc. |
| **METALS, &c.** | | | |
| Aluminium Wire, in ton lots .. per ton | £224 | £224 | .. |
| b „ Sheet, in ton lots.. per ton | £191 | £191 | .. |
| p Babbitt's metal ingots .. .. per ton | £85 to £145 | £85 to £145 | .. |
| c Brass (rolled metal 2" to 12") basis per lb. | 8d. | 8d. | .. |
| c „ Tube (brazed) .. .. per lb. | 10d. | 10d. | .. |
| c „ „ (solid drawn) .. per lb. | 9d. | 9d. | .. |
| c „ Wire, basis .. .. per lb. | 8¾d. | 8¾d. | .. |
| c Copper Tubes (brazed) .. .. per lb. | 11¼d. | 11¼d. | .. |
| c „ „ (solid drawn) .. per lb. | 11¼d. | 11¼d. | .. |
| g Copper Bars (best selected) .. per ton | £86 | £86 | .. |

| METALS, &c. (*continued*). | This week. | Last week. | Inc. or Dec. |
|---|---|---|---|
| g Copper Sheet .. .. .. per ton | £86 | £86 | .. |
| g „ Rod .. .. .. per ton | £86 | £86 | .. |
| c „ (Electrolytic), Bars .. per ton | £83 | £83 | .. |
| c „ „ Sheets.. per ton | £92 | £92 | .. |
| c „ „ Rod .. per ton | £86 | £86 | .. |
| c „ „ H. C. wire per lb. | 9¼d. | 9¼d. | ⅛d. inc. |
| f Ebonite Rod .. .. .. per lb. | 8/- | 8/- | .. |
| f „ Sheet .. .. .. per lb. | 5/- | 5/- | .. |
| n German Silver Wire .. .. per lb. | 1/6 | 1/6 | .. |
| h Gutta-percha, fine .. .. per lb. | 8/- | 8/- | .. |
| h India-rubber, Para fine .. per lb. | 4/6 | 4/6½ | ½d. dec. |
| i Iron, Charcoal Sheets .. .. per ton | £18 | £18 | .. |
| i „ Pig (Cleveland warrants) per ton | 69/4½ | 69/9 | 4½d. dec. |
| i „ Forgings, according to size per ton | From £11 | From £11 | .. |
| i „ Scrap, heavy .. .. per ton | £14 5 | £14 5 | .. |
| i „ Wire galvanised No. 6 .. per ton | £16 10 to £16 11 3 | £16 11 3 to £16 12 6 | dec. |
| g Lead, English Ingot .. .. per ton | £18 | £18 | .. |
| g „ „ Sheet .. .. per ton | £18 | £18 | .. |
| m Manganin Wire No. 20.. .. per lb. | 8/- | 8/- | .. |
| g Mercury .. .. .. .. per bottle | £9 12 6 | £9 12 6 | .. |
| d Mica (in original cases), small per lb. | 3d. to 9d. | 3d. to 9d. | .. |
| d „ „ „ medium per lb. | 1/9 to 2/9 | 1/9 to 2/9 | .. |
| d „ „ „ large per lb. | 3/3 to 7/3 | 3/3 to 7/3 | .. |
| p Phosphor Bronze, plain castings per lb. | 1/1 to 1/4 | 1/1 to 1/4 | .. |
| p rolled bars & rods per lb. | 1/1 to 1/4 | 1/1 to 1/4 | .. |
| p „ r'l'd str'p & sheet per lb. | From 1/3 | From 1/3 | .. |
| o Platinum .. .. .. .. per oz. | £3 11 | £3 11 | .. |
| p Silicium Bronze Wire .. .. per lb. | 10½d. to 1/ | 10½d. to 1/ | .. |
| i Steel, Magnet, acc'd'g to desc'p'n p. ton | From £15 £58 | to £40 £58 | .. |
| i Steel, Magnet, in bars .. .. | | | .. |
| g Tin, block .. .. .. .. per ton | £147 10 to £148 10 nom. | £148 to £149 nom. | 10s. dec. |
| g „ foil .. .. .. .. per lb. | 1/9 | 1/9 | .. |
| n „ wire Nos. 1 to 16 .. .. per lb. | 1/10 | 1/10 | .. |
| p White Anti-friction Metals— | | | |
| "White Ant" brand .. per ton | £40 to £70 | £40 to £70 | .. |
| j Yarns, Cotton, Single 10lb. bundles pr lb. | 8d. | 7¾d. | ⅛d. inc. |
| j „ Best Flax, 6 lea. .. per lb. | 5½d. | 5½d. | .. |
| j „ Hemp, 8 ply 10 lbs. .. per lb. | 4½d. | 4½d. | .. |
| j „ „ Russian, 10 lbs. per lb. | 5d. | 5d. | .. |
| j „ Jute, 180 lbs. rove .. per ton | £15 | £15 | .. |
| k Zinc, Sheet (Vielle Montagne bnd.) p.t. | £27 5 nett. | £27 5 nett. | .. |

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e Frederick Smith & Co.

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

## REFUSE DESTRUCTION AND ELECTRIC LIGHTING IN BERMONDSEY.

### Criticisms of the Consulting Engineers.

After a short discussion the Bermondsey Vestry, on Monday night last week, finally settled the question of the refuse destructor to be used in conjunction with the electric lighting station. The subject was introduced by Mr. T. Cox, who mentioned that the Electric Lighting Committee had inspected the destructors at Leyton, Shoreditch, Clerkenwell and Brixton, and that they had selected the type in operation at Leyton for the approval of the Vestry. The tenders had been under the consideration of the committee and the consulting engineers, and the latter had prepared a special report on the schemes.

It may be well to recall the fact that the Vestry invited tenders for a six-cell destructor to destroy 50 tons of ashbin refuse in a working day of 22 hours, for three water-tube boilers, fans, and motors for forced draught, flues and economiser, and sundry works. Alternative offers were required for the boilers, but, as the original scheme has been extended, the seven tenders recently received have been considered only in so far as they relate to the inclusion of the larger size of boilers. On this basis the tenders are as follows, the water evaporated being that guaranteed by the respective firms:—

| Name. | Large boilers (2,010 sq. ft.) | Water evaporated per lb. of refuse burnt. |
|---|---|---|
| 1. W. F. Mason, Limited | £6,123 10 0 | 1 lb. |
| 2. Willoughby Destructor Syndicate | 6,250 0 0 | 1½ |
| 3. Heenan & Froude | 7,400 0 0 | 1—1½ |
| 4. J. Baker & Sons | 8,199 7 9 | 1½—1½ |
| 5. Hughes & Stirling | 10,242 0 0 | 1—1½ |
| 6. Manlove, Alliott & Co. | 11,300 0 0 | 1 |
| 7. Horsfall Destructor Company | 11,952 12 0 | 1 |

As the subject is of considerable interest, no apology need be made for quoting at some length from the exhaustive report on the tenders by Messrs. Kincaid, Waller & Manville, who state that the two lowest tenders are for two destructors of more or less novel designs. The prices of these should naturally be very much lower than for the others, as the work and material involved in their construction is so much smaller than the more ordinary designs. Proceeding to criticise the proposals in detail, the consulting engineers consider the tenders in the order of their prices. They state:—

1. Messrs. W. F. Mason, Limited, whose tender is the lowest of all, at £6,123 10s., do not propose to burn the refuse in the more usual way by completing its combustion in each cell by burning it on the fire-bars and allowing the gases produced by its combustion to pass immediately to the boilers; their system, in place of this, involves the refuse being burnt at a comparatively low temperature in one portion of the cell, the air admitted to this portion of the cell through a steam jet blower being only sufficient to burn the refuse at a low temperature, and to cause the burning refuse to be largely destructively distilled, and the gases produced by this destructive distillation are mixed in a further section of each cell with a fresh quantity of air, the burnt products of combustion, thence passing to the boilers in the ordinary way. In fact, they term their destructor as a "refuse gassifier," which name perhaps explains their method fairly completely. They omit from their tender the economiser as specified, since they state that one is not required with their arrangement. This, however, we cannot admit, as an economiser would be just as useful in extracting the remaining heat from the gases passing through the boilers with their arrangement as with any other. They further tender for a type of boiler which, in our opinion, will be very difficult to clean and maintain, especially having regard to the hardness of the London water, with which they would be fed; and the arrangement of their gassifiers involves the boilers being placed outside the regular boiler house, as shown on their plan, necessitating extra buildings to cover these in. They further only provide one flue in place of two, as specified, although they state, and probably with accuracy, that as no dust can be carried over in this arrangement, it is not necessary to have a second flue, so as to enable cleaning to be done without stopping the working of the destructor. They also do not include the fans specified, only using a steam blast; but this arrangement also is probably all that is required for this particular type of destructor. Should you consider the tender of this firm, it will be necessary to add to their price the cost of the extra buildings required and the cost of an economiser; and you will, no doubt, with such a comparatively novel arrangement require to be fully convinced of its efficacy.

2. The firm tendering next higher in price are the Willoughby Destructor Syndicate, at £6,250. This firm also proposes a comparatively novel arrangement. They propose to put in two furnaces in place of six, each furnace being able to deal with the total quantity of refuse required to be burnt in a day of 22 hours. The furnaces consist of long iron tubes lined with firebrick, and continuously revolve. In front of the furnace is placed a cell in which coal, coke, or other fuel is burnt, by means of which the refuse in the tubular furnace is kept well burning; and it is to be remarked that this is the only tender in which it is proposed to use extraneous fuel in order to complete the combustion of the refuse itself. In a pamphlet accompanying their tender the syndicate states:—"Anyone who has had experience in the cremation of refuse will know that many tons of coke are used in getting the cells and other destructors sufficiently heated to receive the refuse, with the result that a mass of clinker is obtained as residue." This remarkable statement all the members of your Committee will no doubt recognise as being entirely inaccurate, and perhaps shows the measure of reliance that can be placed upon the statements of this company. They, further, do not conform to the specification in several respects—only, for instance, tendering to put in two boilers in place of three. It is true that the two boilers are of the same capacity as the three specified; but it is essential in your case to have three, and not two, boilers, so that when one is stopped for repairs or for cleaning, you may still have two-thirds of the total possible output. Therefore it would be inadmissible to put in only two boilers of larger size, leaving altogether out of consideration the fact that two boilers, having between them the capacity of three would not be so expensive.

3. Passing then from these two tenders, which differ so materially from the rest, the lowest in price of those tendering for the more usual forms of dust destructors, are Messrs. Heenan & Froude, of Manchester, who quote £7,400. This firm tender for what they call the "twin cell" destructor. They propose to place two cells under each boiler and to arrange the boilers in a somewhat novel manner. Each boiler being placed directly over the tops of a pair of cells, the gases pass directly from the burning refuse in the cells through the top into the boiler. This arrangement involves the burning of any additional coal that may be required to raise steam beyond that produced by the burning of the refuse in the destructor cells themselves, mixed with the refuse in place of being burnt on the firebars of the boiler immediately beneath the tubes; and we cannot believe that the same efficiency can be obtained from the burning of the additional coal in this manner as would be the case if it were burnt independently on the boiler firebars. They guarantee 1 to 1½ lbs. of water evaporated per 1 lb. of refuse burnt. The arrangement of the boilers is somewhat awkward, though the arrangement fits exceptionally well into the space provided for the destructor cells and boilers in the boiler house, and takes up less room than any of the other arrangements proposed. We are not aware that this firm have had much experience in the construction of dust destructor furnaces. They mention the fact that they have at present in hand similar plants for the Corporations of Gloucester and Blackburn; but they do not state that they have any of their destructors yet running.

4. The tender next in advance of that of Messrs. Heenan and Froude, is that of Messrs. J. Baker & Sons, of London, whose price is £8,199 7s. 9d. It is to be noted that this price includes five cells in place of the six specified, though the five cells seem to be amply large to burn the specified quantity of refuse, the grate area of the cell being very great. Their drawing, however, shows six cells, and from the way in which these cells are arranged in conjunction with the boilers, we do not see how the third boiler could be efficiently fired with refuse, unless it had a cell on each side of it, in place of a cell on one side, as would be necessary if only five cells were to be provided; and if you should think fit to consider this firm's tender, we think it should be subject to a sixth cell being added, and if necessary, the grate area of the others somewhat reduced. This may, however, increase their price. The design of cell proposed by them is in a good many points distinctly original. In place of a common air duct, supplying the whole of the destructor cells with forced draught, a separate fan and motor is provided with each cell, making each one independent, and enabling the gases produced during the drying of the refuse to be drawn off and returned under the fire bars. The arrangement proposed seems to provide very effectually for the combustion of the refuse, but there are several points in which they have not followed the specification in the general arrangement of the plant, which we are of opinion would require modification, should you be inclined to accept their tender. They have, for instance, placed the economiser under the inclined roadway; we specially put it outside the inclined roadway in order to admit of the tubes being drawn out when required, which would not be possible in the position shown by Messrs. Baker & Sons. The arrangement of flues also does not comply with that stipulated for in the specification, as in their design there is one portion of the flue which could not be cleaned whilst the boilers and destructors were at work. The re-arrangement necessary in order to enable this to be effected might materially affect their price. They show the destructor built at various levels, and quote extra prices for excavation, should it be decided to place the destructor-house below floor level. They also quote an extra price for a clinker conveyance, in place of handling the clinker in the usual way; and this seems a desirable improvement, if it should work well in practice. They also quote an extra price for a cremating furnace for dead animals, if required to be included with the dust destructor cells. This was not specified, and, so far as we are aware, has never entered into your considerations. We think that the chief point against this firm's tender is the fact that their practical experience of dust destructor construction must be very limited, since they only refer to one destructor which they have *recently* erected in Lambeth for the Clerkenwell Vestry; and they do not state whether the various novel arrangements they propose in their tender to you are actually in work there or not.

5. The firm tendering next higher to Messrs. Baker & Sons are Messrs. Hughes & Stirling, of Liverpool, who quote £10,242. The arrangement proposed by this firm consists in placing two destructor cells with the combustion chambar in between, in front of each of the three boilers, and arranging the firing of the boiler with coal on its own firebars at the side. This firm state that the arrangement proposed is similar to those constructed by Messrs. Beaman & Deas, but with certain improvements introduced by their engineer, Mr. Liversedge, who has constructed a number of the dust destructors erected by that firm, of which a list is given. We believe that you inspected a destructor of this type at Leyton. They have shown their boilers and cells in a different position within the destructor house to that shown in the specification; but if necessary, the arrangement there proposed could probably be adhered to by them without much difficulty. One important modification from the design shown by most of the other destructor makers, is the existence of the tipping floor over the stoking space in place of at the back of the cells. The arrangement generally seems a suitable one, and

there can be no doubt that the experiences so far gained with this type of destructor have been satisfactory.

6. The tender next in advance of that of Messrs. Hughes & Stirling, is that of Messrs. Manlove, Alliott & Co., at £11,300. This firm propose to put up a destructor exactly in accordance with the specification, and make no comments or alternative propositions. They, of course, have had a very large experience in dust destructor work, and, as you will recollect, were the contractors for the combined dust destructor and electric lighting station at Shoreditch, which was the first of its kind to be erected.

7. The next and highest tender is that of the Horsfall Destructor Company, at £11,952 12s. This company, as you are aware, is also one that has had very large experience in the construction of dust destructors, and has erected many that have given excellent results. They propose a novel arrangement of cells and boilers, for, in place of allocating particular cells to particular boilers, they set the whole six cells into two banks, feeding into a common flue, which carries the hot gases produced by the whole six cells to the battery of boilers, the gases being divided between the three boilers at will by means of suitable dampers. They advocate this arrangement since they state that the clinkering of one cell does not interfere with the average temperature of the gases proceeding from the remainder of the cells to the boilers; and there seems to be a good deal of reason in this contention. Against it, however, must be set the disadvantage of the comparatively long brick flue between the cells and the boilers. As you are probably aware, the brickwork of the flue would radiate a considerable amount of the heat contained in the gases during their passage from the cells to the boilers; and apart from other considerations, there can be no doubt that it is better to make the passages between the cells and the boilers as short as possible on this account. The details of the cells they propose are of the very latest type, and are first class in every respect.

The Electric Lighting Committee recommended the acceptance of the tender of Messrs. Hughes & Stirling, amounting to £10,242, and, after discussion, the proposal was unanimously adopted.

## BRITISH TRAMWAY DEVELOPMENT.

Although in the later applications of mechanical traction to tramways this country is still far behind what has been accomplished in other countries, there is nevertheless a certain amount of interest attaching to the development of the tramway, even if it mainly demonstrates how a modern improvement may be for a time stifled by the active opposition of a certain section of the public, and by the difficulty of securing Parliamentary powers. Just as the violent antagonism of land owners, local authorities, and in some measure that of the Press, delayed the introduction of electrical methods of working tramways, so did the opposition of property owners prevent for a period the use of horse tramways. He would be a bold man who, to-day, proposed to construct a line of tramways along the Bayswater Road to Marble Arch, yet such a proposal was actually carried into effect as long ago as 1860. Despite the official opposition of the Chief Commissioner of Works, and the flat refusal of Parliament to grant powers, George Francis Train, under agreement with the local authorities, actually laid down lines from the Marble Arch along Bayswater Road, from Westminster to Victoria Station, and on the Surrey side from Westminster Bridge to Kennington Park. But public feeling was overwhelmingly against the innovation, and amidst a storm of disapproval, the lines were abandoned after a brief existence.

Apart from being one of the earlier pioneers of tramways, George Francis Train deserves our admiration for the courageous manner in which he carried out his schemes in face of the opposition of Parliament and the public. One cannot help feeling that such a man would have been useful in later days when the electrical industry was practically strangled by preposterous legislation. An entertaining chapter in the development of British tramways is contributed to *Cassier's Magazine* for this month by Mr. J. Clifton Robinson, and though the remarks of the writer are, as regards electric tramways, confined to systems with which he is personally associated, and can hardly be taken as indicative of the progress that is being made generally, there is a good deal of information given which is extremely useful at the present juncture. In laying bare some of the mysteries that have hitherto surrounded the introduction of tramways into this country the article is of some value, and the illustrations of the early lines of Birkenhead and London ought to be of extreme interest to all who are associated with this method of traction. It has been frequently asserted of late, more especially by professional cynics, that tramway tracks are a measure of the badness of the roads, but, curiously enough, the development of the tramway in this country has proceeded almost simultaneously with the improvement of road surfaces. One quite appreciates the fact that motor cars might possess a greater degree of usefulness as public conveyances if roads were uniformly good, but one cannot have asphalte everywhere; moreover, does it not appear reasonable that a vehicle carrying 60 passengers, for which the modern tramcar is made, would be better confined to a specially made track, rather than be permitted to select its own route? Besides, tramways do aid very materially in preventing blocks in crowded thoroughfares. A tramcar is rarely hung up in the same manner as an omnibus, for it is recognised by the drivers of ordinary vehicles that a tramcar has a prescriptive right to its route, whereas a motor car possesses no more than the ordinary rights of road. No doubt the extraordinary development of tramways in America was mainly due to the inordinate badness of the roads; but in spite of the improved methods of street paving that are in vogue in this country, tramways are extending with marked rapidity, so one can hardly say nowadays that a tramway system is not due to something more than bad paving.

The early systems of Train, though carried out long after attempts made in America, were in London foredoomed to failure on account of the construction of the permanent way. He adopted what were known as "step rails," composed of rolled steel, and weighing about 50 lbs. per yard; they were spiked to pieces of timber laid longitudinally, these in their turn being spiked to cross ties. The track of the rail was about an inch lower than the carriageway adjoining the track, and as the gauge of the tramway was just the width of a carriage, it became almost impossible for a carriage to leave the step of the rail without a violent wrench, and occasionally the loss of a wheel. This was one of the objections on which the opposition of the public was based, which ultimately culminated in the abandonment of the line. Whether it is that usage does much to break down opposition is difficult to say, but one has even recently heard the present tramway companies deeply anathematised on account of the difference of level between the rails and the road surface. Train was much more successful in his attempts to carry out his tramway system in Birkenhead, and apart from a subsequent alteration of the rails, the track which he laid down in 1860 still forms part of the present tramway system. This was followed by a system between Burslem and Hanley which, until recently, was used as part of the North Staffordshire Tramways. Mr. Train next introduced tramways into Darlington, which have run without intermission to the present time, though they are about to be converted into electric tramways. Improvements in rails and track construction followed Train's early efforts, but it was not until 1878 that a system was arrived at which gave much promise of permanence; this was based on the Gowans girder rail, which weighed from 73 to 100 lbs. per yard. In Edinburgh, where the method was employed, the girder rails were laid in a bed of concrete, the paving consisting of granite sets. Chilled steel blocks with diced surface were laid alternately with the granite blocks at each side of the rail, the whole being thoroughly grouted and bonded together with bituminous tar.

With the great increase in cost of the road bed, which became necessary to give efficient working, it soon became apparent that horse haulage absorbed too much of the revenue. There were not only the normal expenses, but horse traction was liable to great fluctuations; the price of fodder, and illness among the stud were matters that seriously affected the financial standing of a tramway concern. Moreover, the question of the load factor with horse traction was an extremely serious one. It was easy enough to reserve cars for exceptional traffic, but standby plant in the shape of horseflesh was always attended with difficulties. Horse tramway companies very soon came to the end of their tether, and the eyes of the tramway manager were directed towards mechanical traction. Naturally the steam engine was first considered, and despite many drawbacks, it became in many districts the accepted form of traction. Although Mr. Robinson does not give much account of the steam trams of the country, we think they have had a not unimportant bearing upon the introduction of electric tramways. It was only by the use of steam that tramways were at all practicable in many of the Staffordshire, Lancashire, and Yorkshire districts, and so useful and convenient did they become to the inhabitants that the evils of steam trams were cheerfully endured. Then came the electrical system with its cleanliness, rapidity, and brightness, and the steam tram was quickly ousted. One can quite appreciate any town after a period of steam trams readily adopting electricity, and this is precisely what has occurred in many parts of the country. Save for the sentimental opposition of the public, the electric method easily carried conviction when arrayed against the horse tramway with its high cost of haulage and slowness of service, and the steam system with its dirt and unsightliness. We are quite aware that the most formidable competitor of electrical methods was the cable, but then it was exceedingly rare in this country, otherwise we think the advocates of electric traction would have had much harder battles to fight. The cable system was entirely free from the objections of the horse and the steam systems, and it had a degree of flexibility which was quite absent from the others. We know now, of course, that it has distinct limitations, but, nevertheless, we have often wondered that cable systems were not adopted to a greater extent before electric methods had become fully worked out.

Mr. Robinson suggests that the development of electric traction in the United Kingdom is the work of the past 10 years, but we should be inclined to say that the real and true development of electric traction is confined to the last four or five years, for it was not until 1895 that a line was constructed in conformity with Board of Trade rules. We quite share the author's opinion that the problem of traction must be faced in a broad and generous way, and it may be said in justice to those who are working on the subject, both municipalities and joint stock companies, that there is not much disposition to treat the matter in any niggardly spirit; in fact, it is a moot point whether the tendency is not rather to exploit traction at the expense of lighting.

Naturally, the author has something interesting to say regarding the lines with which he is mostly associated, but he would have been treating the subject in a more comprehensive way if he had made more than passing reference to what is being done by the great municipalities and by private enterprise in different parts of the country. The Stockton and Middlesborough tramways, no doubt, embody the very latest practice in tramways, and in the system that is being carried out on the London United Tramways, there is much which will interest most engineers. We are permitted a glimpse of what is being done there, not only by a view of a temple-like structure which is to do duty as a power house, but there are some interesting details of the line which, however, may or may not be altered with the sanction of the Board of Trade.

There are points of real interest raised in the article, and not least is one relating to the type of cars. It is probably among many

traction engineers still an open question whether it is better practice to use trailers or a larger type of trolley car running at frequent intervals. The experience at Stockton is unmistakably in favour of the latter practice. Although the gauge is only 3 feet 6 inches, a special car has been constructed capable of carrying 60 passengers, which is distinctly creditable to the car builders, though one might be permitted to doubt how far such a type would be useful on less crowded lines than prevail in the Stockton district.

We have often in these columns expressed regret at the amount of secrecy which the managers of electric tramways displayed on the question of cost of operating lines; as Mr. Robinson has been concerned in a few electric lines, it is distinctly interesting to have from him an authoritative statement as to what the actual cost is on lines with which he is associated. Broadly speaking, he states that the cost of operation of a first-class electric line amounts to 5d. per car-mile run, and what he has actually experienced works out as follows:—

| | |
|---|---|
| Power house ... ... ... ... | 0·773d. |
| Traffic expenses ... ... ... ... | 2·503d. |
| Maintenance and renewal ... ... | 1·009d. |
| Local rates and taxes, &c. ... ... | 0·715d. |
| | 5·000d. |

He finds the energy per car-mile is 1·046 KW.-hour, and adding the proportion for maintenance and renewal, this is produced at a total cost of 0·903d. per unit.

## COUNTY OF LONDON AND BRUSH PROVINCIAL ELECTRIC LIGHTING BILL.

We are indebted to the *Times* Parliamentary columns for the following report of the proceedings in the House of Commons on Monday night on the motion for the second reading of the above Bill:—

Mr. Pickersgill (Bethnal Green, S.W.) moved that the Bill be read a second time upon this day six months. He said that the object of this measure was to amalgamate eight or more separate undertakings into one gigantic concern. In order to achieve that end the promoters asked for powers to establish some half a dozen central generating stations, and to link up the various portions of their area of supply. The latter object involved the laying of new lines and the consequent breaking up of streets within the area of supply. It also involved the giving to the company of powers to break up streets in six districts — Islington, Shoreditch, Battersea, Lambeth, Bermondsey, and Whitechapel — in which at present they had no *locus standi*. If the Bill passed, the people of Shoreditch, for instance, who now supplied themselves with electricity, would have to submit to the inconvenience of having their streets broken up for the purpose of supplying some district beyond Shoreditch which was at present supplied from another generating station; that was to say, the company were to be authorised to break up the streets without giving any compensation to the public. It seemed to him that the company ought not to receive such powers without the sanction of the community expressed through the local authority. Furthermore, by the Bill the company were breaking faith with those local authorities who had consented to the various orders under which the company had established their eight separate electric lighting undertakings. The power of purchase which the local authorities now possessed would be rendered entirely illusory if by this Bill the House consented to each separate undertaking becoming part of a gigantic undertaking stretching over almost every part of London. In conclusion, he pointed out that the preamble of the Bill was last year thrown out by a Committee of the House.

Sir A. Rollit (Islington, S.) as the representative of one of the districts affected by the Bill, seconded its rejection. The Bill was an attempt to override by private legislation the general law of the land, especially the provisions of electric lighting Acts, which required the consent of the local authorities for carrying out such undertakings. Among the powers asked for by the Bill was one to break up roads and streets not only of districts interested in the supply, but of intermediate districts which got no benefit from it whatever. He was sure the House would not sanction such a provision. As the local authority had the interests of the community most at heart, every undertaking of this kind should have its approval.

Mr. Kimber (Wandsworth) submitted that none of the reasons advanced against the Bill afforded any reason why the House should depart from its usual course of sending such measures to be fully investigated by a Committee. The powers asked for by the Bill for breaking up the roads and streets of intervening districts struck one at first sight as being strong. But Parliament, in its wisdom, had entrusted private companies with the carrying on of industries like electric lighting, and it was bound to give them every facility for carrying out their undertakings in the most economical and approved manner. If the Bill were sent to a committee, evidence would be taken in regard to all the objections advanced against it.

Mr. Burns said that, as the representative of one of the intervening districts, he supported the rejection of the Bill. He regretted that the Bill had not been postponed until the House had come to a decision with regard to the general electric lighting Bill which would come on towards the end of the week. He objected to the Bill because it sought powers to cut up an intervening area which it was not authorised to supply with electricity, because its housing scheme was very defective, because it sought to abstract water from the Wandle, and because no protection was given to the consumers in the event of the electric supply failing.

Mr. Marks (Tower Hamlets, St. George's) also supported the rejection of the Bill. In November next, he said, the new London municipalities would come into existence. Great things were hoped from them, and not the least of those great things had reference to electric lighting and electric facilities. He therefore urged upon the House not to allow this company to come in at the eleventh hour, before these new authorities were in a position to establish their own electric lighting plant, with a Bill like the present one, which was not for the purpose of supplying the plant, but of creating an amalgamation which would make the question of the purchase of existing plant by local authorities more difficult if not impossible. They should give these new municipalities every power and every possible opportunity of carrying on their business profitably and usefully, and therefore he hoped the House would order the Bill to stand over for the present.

Sir J. Fergusson (Manchester, N.E.) urged that the House should not, on *ex parte* evidence, reject a Bill at this stage when they had provided machinery for thoroughly investigating the facts and judging whether there were any public or private reasons why the Bill should not proceed. He could not agree that anything had been said to induce the House to depart from the wholesome rule almost invariably observed in these matters.

Mr. Boulnois (Marylebone, E.) said the proposal of this company, in which he had absolutely no interest, to pass through an intervening area was not a novel one. Last Session two electric lighting companies obtained Acts which gave them power to pass through districts, although they were not actually authorised to supply light or energy in those districts. This Bill would only facilitate the distribution of the electric light, and it would in no way interfere with the rights or powers of any municipality or local body. What, he asked, would be the position of London with regard to the electric light if it had been left to the municipalities?

Mr. Buxton (Tower Hamlets, Poplar) complained that the House had received no guidance with regard to the Bill from the Local Government Board. Under the circumstances of the moment, with the new local bodies coming into existence, he thought the Bill might very well stand over for this Session.

The House divided, when the numbers were—

| | |
|---|---|
| For the second reading... ... ... ... ... | 105 |
| Against ... ... ... ... ... ... ... | 147 |
| Majority ... ... ... ... ... ... | —42 |

The Bill was therefore lost.

## THE UTILISATION OF WASTE HEAT.

It must be a surprise to most engineers to read so often in the discussions of marine men of feed heating as some new thing. Yet it is a fact that the heating of feed water at sea is probably more often effected by live steam in a Kirkaldy heater than in any other way. We have nothing to say against the system of live steam heating *per se*, but it certainly does appear strange when, as the *Engineer* points out, there is so much heat going to waste from the funnel, that some of this wasted heat cannot be used for feed heating. The live steam heater saves no fuel that would not, to say the least, be saved by any system of feed heating by the same peculiar action, if such really exists, that is held to explain the paradoxical saving due to the live steam heater. This economy we say would be secured by any form of flue feed heater, as well as the economy due to the use of otherwise wasted heat. The *Engineer* asks why feed heater coils cannot be placed in the bases of the funnels of steam ships. These funnel bases radiate an enormous heat, as is so pleasantly apparent to the passenger who shelters on the lee of the casing. One-tenth of the heat wasted to produce a good chimney draught is the *Engineer's* estimate of the power required to drive a fan to give as good a draught, but one variable to suit atmospheric conditions. In an electric light station the occurrence of a fog that will make an enormous demand for light, and therefore, of course, for steam, is Nature's opportunity to choke down the chimney draught. Just when good draught is most needed, it fails. A fan saves the expense of a very costly chimney, and new works are advised to carefully consider between them and fans, which cost less, are movable, and can be driven for so small a proportion of the waste heat. To secure this last advantage, however, the use of a fan must be made the occasion really to economise such waste heat. We do not see very well how this can be done, unless the water heating surface is very considerably extended beyond present allowances. The feed heater would require to be graded in series of two, or even three, sets of pipes of the Green type, and possibly a final saving might even be effected by means of an air heater. We are inclined to doubt the utility of any system of air heating by means of tubular heaters. They seem to us of far too costly a construction for their purpose and capacity. The kind of heater that appears to offer itself is one somewhat after the fashion of the hot blast stove, a system of brick chequer work in two chambers placed alternately in the course of the incoming and outgoing air.

The recognition of the steam engine as a far more efficient machine than it was once customary to consider it under the misapprehension of the true theory of heat has thrown the onus of wastefulness upon the boiler. Whereas 1 lb. of coal will theoretically evaporate about 15 lbs. of water, it is looked on as doing well if it evaporates

10 lbs., or even 9 lbs. Practically the bulk of the loss is evenly divided between the chimney heat and the incompetence of the fireman, and this must ever be the case while the attempt is made to burn coal in thin layers, for want of a draught sufficient to deal with it in thick layers; and in water-cooled furnaces. The most skilful fireman cannot keep excessive air from passing a thin fire unutilised, nor can he prevent smoke with the poor draught on a thick fire, or in a water-cooled furnace. With a fan draught all conditions may be improved, but it would be more than useless to employ good fan draughts unless there are suitable fires for the air to serve. Apart from, if not beyond the question of feed heating comes that of reduced air supply. The 50 per cent. to 100 per cent. excess of air carries a correspondingly greater amount of heat to waste at any temperature, as well as offering a much greater volume of gas to be dealt with by each unit of heating surface placed to absorb the heat. The heat is reduced in intensity and distributed through a greater volume of air, and is correspondingly more difficult to deal with. If steam power is to hold its own with gas power, it is likely that a change will require to be made in the methods of burning coal, so as to secure combustion with a minimum of air, and within more suitable furnaces as regards lining. As matters are now arranged, we find professors blaming the coal, and some men going so far as to say that all the hydrogens of bituminous coals must be wasted. Yet petroleum is all hydro-carbon, and, next to electricity, is the cleanest means of artificial light, and can be easily burned smokelessly for steam generation. It is the furnaces, not the coal, that are in fault.

## BOILER EXPLOSIONS.

The ordinary practical repairing boiler maker may, says the *Practical Engineer*, be quite an expert at his work, yet totally unable to gauge the suitability of a boiler for a given pressure. In a recent report of the Board of Trade on an explosion (Report No. 1,176) it appears that a boiler of unknown age that had been twice sold as second-hand, was pronounced by a working boiler maker as fit for 70 to 80 lbs. pressure, though the boiler had previously been insured at 40 lbs., not that this, however, means of necessity that it was only fit for this pressure. The old weight on the safety valve was increased and the boiler worked at 70 lbs.

It was vertical, 9 feet diameter and 9 feet 2 inches high, and had a firebox 4 feet 4 inches diameter and 4 feet 1½ inches high of $\frac{3}{8}$-inch plates, with a 4½-inch dish upwards of the crown, which was flanged in the usual way to the firebox barrel. The boiler exploded, and flew 400 feet, killing the fireman. It was found that the firebox was badly pitted on the water side and the pits had been carefully filled with cement. The plates in places were only $\frac{1}{16}$-inch thick, but the average thickness ranged from $\frac{1}{4}$-inch to $\frac{3}{16}$-inch.

When the last purchase was made the insurance policy was handed over with the boiler, and the 40 lbs. pressure was noticed to have been changed to 70 lbs. from some other figure, but the purchaser believed this to have been a *bonâ fide* alteration, and for anything he knew the original figure may have been 90 lbs. The moral of this is that all alterations ought to leave the original reading still visible, and the alteration should be in red ink and dated so as to be in evidence.

It is no unusual thing for a boiler to be refused at, say, 50 lbs. pressure, and afterwards accepted by the same company at, say, 60 lbs. There is nothing to grumble or feel nervous about in this. A boiler long set in a damp place may be far from fully visible, and this same boiler, when inspected in a broker's yard, is probably fully in view, and not so bad as its situation originally gave grounds for believing it might be, and we should never cavil at such a higher pressure being admitted, but the changes allowed should be visible, and done in a manner to form connective history. In the boiler insurance companies' records, all that happens to a boiler is put down; every boiler ought to have an original deed like a piece of land, and this deed should be brought to date annually by the insurance company and pass with the boiler. Were this the practice, a purchaser of a second-hand boiler would naturally want to see its deed, and a properly attested form of this kind would place the perfectly legitimate trade in second-hand boilers upon a sound and safe basis. At present, it is not safe to buy a second-hand boiler from a dealer. These second-hand dealers appear to be absolutely ignorant, where they are not worse, and nothing but the fear of a charge of manslaughter deters some of them from swearing to anything. The honest men would welcome the system we suggest. In the case in point serious alterations had been made in the letter of the boiler insurance company describing the condition of the boiler. The letter had been torn. The commissioners appointed to investigate thought that the boiler broker had done this, for his written 7 corresponded with the 7 of the alteration in the 70 lb., but the broker was given the benefit of the doubt that still remained.

The purchaser was let off because it was found that he really believed the working boiler maker was a competent judge of the proper pressure, but it was a question if he was justified in forming such a belief as a steam user, and an employer, and a business man; but then he had followed the advice of his boiler makers, and was not held blameable. The working boiler maker had not even examined the boiler, but had apparently done his best to get it sold so that he might have the job of repairing it. We think he got off very easily with a fine of £15 in the shape of a contribution to the costs of the inquiry. He had even cemented pitted holes level, so as to facilitate the purchase of the boiler.

We wish it could have been positively ascertained who had falsified the documentary evidence of the boiler's condition.

We should like to see the second-hand boiler question tackled in a much more businesslike and purposeful manner than by the milk-and-water methods of these farcical Board of Trade inquiries.

## THE MAXIMUM-DEMAND SYSTEM OF CHARGING FOR ELECTRICAL ENERGY.

By W. PERREN MAYCOCK, M.I.E.E.

The maximum-demand system is a method of charging for the supply of electrical energy which is already very widely adopted in this country, and is yearly increasing in favour with those who have the management of affairs. It is one of the most rational in existence, but, unfortunately, is not easy to grasp at first, a fact which often leads to much friction between the suppliers and the supplied, the latter seldom being able to understand the reasons for the apparently wholly unreasonable fluctuations which characterise their quarterly accounts. It is the object of this article to give the reasons for and to explain this system in a manner which will make it clear to the uninitiated. *En passant*, it may be mentioned that a short account by me of this method and its birthplace appeared in the issue of this journal for February 28th, 1896; and that a fuller and illustrated description of the rebate indicator and its use was given by you in the issue for November 6th, 1896. Other articles may have since appeared, but I do not remember any, excepting, of course, that by Mr. Louis J. Steele, on the "Wright and other Maximum Demand Indicators," in the issue of January 5th last.

The fact that the system is in use in no less than 84 of the 290 or so cities, towns, and districts now supplied with electrical energy, may be taken as indisputable evidence of its merits, particularly when it is borne in mind that it is comparatively a new system, and that it has ousted, and is ousting, various other methods of charging that have been tried and found wanting. The majority of the places where the maximum-demand system is not as yet in vogue are small towns and villages where the necessity of adopting a strictly equitable method of charging has not apparently been considered of vital importance, so that the figures given above are by no means so much against the demand system as would appear to be the case. To obtain a fair basis for comparison, it would be necessary to consider the total number of lamps supplied on this method, and to find what proportion this bore to the total number in use in the United Kingdom, which latter, by the way, is now equivalent to over 7,000,000 8-c.p. lamps, the increase during the past 12 months being 1¾ millions.

At a rough estimate it may be said that about one-third of the total lamps in the kingdom are charged for on the maximum-demand system. Out of the 38 metropolitan and suburban areas of supply it is adopted in 18, or practically one-half; whilst among the large towns where it is in use may be mentioned Aberdeen, Belfast, Birkenhead, Blackburn, Bolton, Brighton, Burnley, Cardiff, Croydon, Derby, Dundee, Glasgow, Hull, Nottingham, Oldham, Preston, Salford, Southampton, South Shields, Sunderland, and Wolverhampton. Had this method of charging been invented some years earlier than it was, there is not the slightest doubt that it would have been already in use in many other towns that, so far, have not taken it up.

When one considers the utterly different conditions under which electrical energy and gas are generated and distributed, it must be evident that the ordinary way of charging in direct proportion to the consumption, which obtains, and is satisfactory in the latter case, would not be so in the former. To the gas company it does not matter very much whether you spread your consumption over a good portion of the dark hours, or crowd it into a very short space of time, except so far as possible alteration of pressure is concerned; but to the electric-light people it makes all the difference in the world. At the gas works generation and storage can go on during the whole 24 hours, if necessary; and, because of the power of storage, the amount of generating plant is very much less than would be requisite had the gas to be got off as fast as, and at the same time as, it was wanted, as

is the case with electricity, especially in alternating-current distribution.

In the electricity works, enough machinery has to be put down to supply the maximum demand at the busiest times in the year, viz., from about 6 to 8 on Saturday evenings during the winter months, particularly just before Christmas. During the greater part of every 24 hours, especially in the spring, summer, and autumn months, the majority of the electric generators are standing idle. But they must be there, nevertheless, and it is just those little sums for interest on sunk capital, upkeep, depreciation, rental, and wages (which have to be found whether the machines are working or not), that furnish the primary reasons for the mode of charging now under consideration.

It may sound startling, but it is nevertheless true, that when an electricity station has a full connection of customers, the plant (boilers, engines, and generators, and so on) have only sufficient capacity to supply a proportion of the total lamps, &c., connected, as, of course, it could never happen that all the lamps in a town were turned on at once. In other words, the quantity of machinery has to be sufficient for the maximum demand at the busiest hour during the year, and it is evident that anything which tends to keep this maximum demand within reasonable bounds will also decrease the proportion of idle or stand-by machinery, and thus keep down the cost of generation as a whole.

It may be thought that as the central station plant is only taxed to anything approaching its full capacity during the winter, the keeping down of the maximum demand in the summer is unnecessary, but such is not the case. The lighting up of extra boilers, and the starting of engines and generators to supply what is known as the "peak of the demand" is relatively an expensive matter; and the lower or flatter this "peak" is kept, whatever the time of year, the greater is the economy effected. By the expression "peak of the demand" is meant a very sudden and extensive switching on of lights for a comparatively short time early in the dark hours, which occurs every day in the year, and requires boilers to be in readiness, and the starting up of extra machines at a few minutes' notice.

It follows from what has just been explained that a customer is not necessarily a paying one merely because he uses a large quantity of electricity; it depends on the time over which his demand is spread. Thus, with a uniform system of charging—so much per unit all through—there are customers who are actually supplied at a loss, and others from whom no profit accrues, the remainder being surcharged to make both ends meet. All that can be said for such a method of charging is that it is very simple and easy to understand, but it is certainly not equitable. It is not sufficient to measure the actual consumption of any customer, but it is necessary, in addition, to take into account the extent and duration of the demand made by him upon the resources of the electric light station, and in particular to ascertain how far he is responsible for the "peak of the demand," which is the cause of the greater part of the expense of running the electric light station. Now this is exactly what the demand indicator does; in other words, it charges a man on what may be termed his "economic merit," as considered from a strictly business point of view, so that an individual who happens to be a regular consumer is not made to pay extra because of the existence of what may be called irregular ones. The regular consumer, be it understood, is the one who burns his lamps for long hours, and does not turn on many extra ones for short periods; the habits of the irregular consumer are just the reverse.

The number of units to be charged at the full price is exactly in proportion to the number of lamps that have ever been burning at once on any day during the quarter for, at least, a sufficient length of time to affect the indicator, i.e., about 10 or 15 minutes. Say a man has 100 lamps on his premises, and that during one quarter the largest number ever alight at once was 80, and during the next three months 60, he will be charged a greater number of units at the full price for the first quarter than for the second, quite irrespective of the total units consumed in each case. The reason for this is that on a particular day or days he drew upon the resources of the central station plant to the extent of 80 lamps, whereas the second quarter the maximum strain he inflicted was only equivalent to 60 lamps.

To get the greatest benefit from this rebate system, it is necessary to be economical in the matter of extra lights. Thus in a house where they are careful to turn lamps off when leaving a room, if only for a short period, the quarterly bill will be appreciably less than for, say, next door, where there may be the same number of lights, but the people addicted to wholesale illumination, whether wanted or not. A customer may say to himself, Why should I be so sparing of the light as all that, just for the benefit of the supply people? But then it must be pointed out that the benefit is not all on one side; it is mutual. It decreases the amount of stand-by plant in the central station, and thus effects economy in the generating expenses for the reasons already given, and it lessens the cost of the light to those who care to be economical in its use. The consumer is not expected to exercise this economy unless he wishes; that is entirely his affair; only he must pay more in proportion if he does not do so. Even if a man, owing to the circumstances of his particular case, is called upon to pay nearly the whole of his bill at the high rate, he ought to reflect that he is getting an excellent kind of light, (the many advantages of which are very apt to be lost sight of) at a low price. If electricity was charged for according to its intrinsic merits as compared with other illuminants, its maximum price would be much higher than it is at present rated at.

Let us now consider extreme examples of the regular and irregular consumer, and endeavour to see that it is only fair and just that the former should pay a less average price per unit than the latter. On the one hand, we have the man who burns a fairly constant number of lamps during the greater part of the evening, and perhaps some all night, and during the day in cellars and dark rooms. Obviously, he makes fairly constant use of the public supply, and is treated accordingly. On the other hand, there is the large householder whose numerous dressing lights are switched on for, say, half an hour before dinner, just at the "peaky" time in the winter. Or the other householder who resides only a portion of the year in town. Or the assembly room proprietor who turns on a large number of lights for a few hours on a few days in the winter, when there is the greatest load on the plant, and hardly uses them at all in the summer. Or the shopkeeper who will have extra illumination at Christmas time. Or the theatre manager with his hundreds of additional lamps for scenic effects, which, as a rule, are only alight for a few minutes.

Every consumer, regular or irregular, must remember that in proportion to the maximum number of lights he has on his premises at any time during the quarter, there is, virtually, a small fraction of electrical plant allotted to his sole use and benefit, which plant has to be paid for, housed, and kept in trim all the year round. Consequently, before he can expect any reduction, it follows that he must pay (so far as the amount of his consumption will allow) his proportionate fractional share of the standing charges on the electricity works (interest, rent, maintenance, and so forth). In some cases, the very irregular consumer does not use sufficient current to enable this charge to be made, so that instead of having anything to grumble at, the fact is that he has actually been supplied with more than his money's worth (owing to the limiting of the maximum price per unit), at the expense of the other consumers. Or it may be that little or no profit accrues from his account. The regular customer pays his fraction of the quarterly standing charges in full, and is afterwards debited with his equivalent of the current working expenses only, hence the substantial reduction which is made in his case.

The demand indicator is a very reliable instrument in its working, and even if quarterly accounts do sometimes show remarkable diversions, it may safely be assumed that there are ample reasons for the same. If people would only reflect on the safety, cleanliness, healthfulness, steadiness, and non-vitiating properties of the electric light, and take into account the many indirect savings effected by its use, they would be forced to admit that it is comparatively cheap at the first or full price, and very cheap indeed at the reduced price per unit.

The public supply of electricity, to be commercially successful, must be carried out on strictly businesslike lines; and the maximum-demand system of charging for that supply is, in the opinion of those who have examined it, and are best fitted to judge, one of the most suitable and equitable in existence.

## LABOUR CLAUSES IN PUBLIC CONTRACTS.

Mr. Benjamin Taylor, F.R.G.S., contributes an article to the February *Cassier's* on the important question of labour clauses in public contracts. The subject is of supreme interest to all electrical contractors who have the misfortune to undertake municipal contracts. Sooner or later there must come a collision between a combination of contractors and the municipalities, and we are almost prepared to say that the labour interest will not achieve a victory. At the same time one cannot fail to recognise that the Labour Party is increasing its hold on the electorate, and in some towns it already possesses the predominating influence. No doubt the movement is what the writer in *Cassier's* terms it, a Socialistic one, but our sincere hope is that it may develop quickly, and public ridicule will eventually kill it.

Yet if one quietly analyses the whole relationship of English capital and labour, taking into consideration the history of the subject, it is obvious that there was bound to be a great reaction against the arduous conditions of labour, and we look upon the somewhat offensive attitude of the Labour Party as part of the reaction. The whole country was staggered at the disclosures which were made before the Sweating Commission of 1891, and in endeavouring to rectify what was a scandalous state of affairs, Parliament and the public provided the organised Labour Party with a weapon which was never intended to be used to the extent that has prevailed. Although the metaphor of the slave making a bad master may be a little strained in its application to the position of capital and labour, there is no doubt that where the professed leaders of labour have possessed power, they have exercised it in a tyrannical manner. Such conduct brings about its own condemnation. The most notable instance of labour ascendency is that of the West Ham Town Council, but do the proceedings of that body claim the attention or meet with the approval of the great majority of the public? Indeed, scarcely anyone speaks of the West Ham Town Council without a smile, and ridicule would kill any elected body, from the Government of the land to the smallest urban sanitary authority. The West Ham authorities are so constituted that they would be inclined to forget their principles at any moment if they perceived any advantage to be gained by doing so, and we shall show an instance of this.

There can be little doubt that when the Government drafted its famous Fair Wage Clause, it was actuated by a desire to see that the worker was fairly well paid, moreover, the contractor, as a rule, saw little to object to, but the interpretation put upon the clause by trade union authorities was quite contrary to what was intended. The writer in *Cassier's*, however, is inclined to take an alarmist view of the matter, for he says the persistent efforts of trade unions and trades council to get their nominees elected on town councils and similar bodies, are merely for the purpose of enforcing upon employers "conditions inconsistent with the maintenance of freedom in the management of their works." But supposing every municipality in the country adopted wage clauses that would absolutely prevent contractors taking contracts, it would not have a very staggering effect on the trade of the country. The prosperity of this nation has not been built up on municipal contracts; the shipping, the railway, the textile, the coal and iron industries, are totally independent of municipal contracts, and it is clear that the influence of trades unions exerted through the medium of town councils must be very restricted. The trade of the country fortunately does not depend upon votes, and while it remains so, one can take a philosophic view of the country's position. While, of course, one may generalise in this manner, the "fair wage" clause, as translated by the local authorities, does press somewhat severely upon the electrical contractor, but if the contractor refuses to accept their rendering, he frequently gets his own way. Even West Ham swallowed its cherished notions regarding labour rather than not put in a special kind of plant which it fancied.

Notwithstanding the checks with which labour town councils have met in regard to some contracts, it is noteworthy how widely the fair wage clause, or some modification of it, has been adopted by local authorities. We are told that in 115 cases the local authorities require current wages to be paid by the contractors, in 34 instances the local authorities specify that wages are to be in accordance with rates recognised by trade unions; in 10 cases the local authorities require wages to be paid at "rates agreed on by associations of employers and employed." Altogether 163 urban districts make stipulations in their contracts as to wages, and it is surmised by the author that this number has been increased of late. It is not only in regard to wages that local authorities consider they have a right to exercise their authority, for 43 urban bodies require that the generally recognised hours of labour of the district or trade be observed, and there are others which insist on variations of this, while some adopt special prohibitions against sub-contracting. Manchester, however, is adopting a distinct treatment of the labour question, by insisting that "the contractor shall execute the works by his own workmen, working directly under the contractor at a daily or hourly rate of wages, and (except with the consent of the Corporation) not by the piece or according to results." It is not clear whether this merely applies to construction, but, at any rate, it can have little effect on the manufacture, seeing that Manchester will have much of its new electrical plant made in the United States.

The action of the Poplar Board of Works in its electrical contracts is noted at some length, and the author gives prominence to the attitude of the Parliamentary and Municipal Affairs Committee of the Amalgamated Society of Engineers, which wrote to the town clerk of Poplar urging the local authority to give the work to a certain firm, which, according to the author, "has won a certain amount of notoriety in connection with the eight hours' movement." It will probably interest a good many people, including the writer of the article in *Cassier's*, to learn that the firm in question absolutely refused to accept the terms of the Poplar Board of Works, and it was not until the clauses had been modified that they accepted the order.

The question must be raised sooner or later as to how far a local authority is justified in carrying out its pet ideas when they may involve an increase in the cost of certain work. For instance, the London County Council placed an order with Messrs. Yarrow & Co., for a steam fire float of a special nature, and sought to embody in the contract certain wage clauses; the contractors refused to accept the terms, and the order was placed elsewhere at a much higher figure. Surely there must be a method of preventing the County Council from spending the ratepayers' money on what are distinctly unnecessary fads. What is, however, a very serious state of things, is that a certain firm are followed wherever they are tendering to public bodies by the Boilermakers' Society, who use all their influence to prevent them from getting the contract. Surely some legal process could be found which might tend to stop what is, in effect, most serious intimidation.

It only needs some sort of co-operation among contractors to strike a severe blow at the interfering policy of municipalities and local authorities, and if there were a general determination to resist unjust clauses and conditions an improved state of things would soon prevail. As an instance of how obnoxious clauses are speedily dropped, it may be mentioned that in March last the Islington Vestry wished to give out a contract with the conditions that the contractors should promise to pay the trade union rate of wages, and cause a schedule of this to be exhibited in their works. Not one of the firms offering would agree to these conditions, and, as the Vestry could not prevail on any respectable firm to accept them, they had to strike out the clauses of their building contract. Tottenham, Leeds and Sheffield have, in their turn, abandoned clauses. There is another phase in connection with tenders that cannot be too widely known, and that is, some of the most prominent firms in the country have decided not to tender for any work offered by certain local authorities. Such are the measures necessary to bring local authorities to a reasonable view of contracts and contractors.

## WHO IS REALLY TO BLAME?

[COMMUNICATED.]

Many suggestions have been made to account for the present unsatisfactory state of the electrical trade from the English

manufacturers' point of view. Some, including the writer of the recent paper on "Standardisation of Plant," blame the idiosyncrasies of the consulting engineer. Others say that it is a result of the growth of municipal trading, whilst many give the workmen and their unions the benefit of having brought on the present unfortunate position. All or any of these may have had something to do with it, but the writer's impression is that a great deal of the blame can be placed at the door of incompetent managers and engineers.

People express surprise that it should be so difficult to obtain financial support for electrical enterprise, and yet how can we expect otherwise? Take the ordinary City man, for example, can one wonder at him still babbling of "electricity in its infancy, very unreliable, &c.," considering the way the lighting of the City of London has been engineered? When lights go out it is no use explaining that the accident was caused by patent coil this, or patent switchgear that—the lights went out, and that is good enough for him. Thus it comes about that the men with money sit tight, and what little is done has to be "pioneered" and underwritten and so forth. In fact, if it were not for the solid work of one or two home firms, and the confidence given by the introduction of certain American engineers and much foreign machinery, we should be much further behind than we are.

An excellent sign of the times is the recognition which our younger engineers are now getting. As draughtsmen or assistants in various departments they have been quietly doing the solid work of the profession for years past, whilst others, wittingly or unwittingly, have had the credit. There need be no fear of them not rising to their increased responsibilities, for an examination into the *personnel* of successful American and Continental concerns will show that all the responsible posts abroad are held by young men. In fact, not a few of the most capable engineers in the States are Englishmen who left this country because, under our slow-coach system, they saw no prospect of attaining to a well-paid responsible position before they were comparatively old. On the other side they found those in authority quick to notice ability and listen to suggestions, and this information coming home in sundry letters caused other promising engineers to go out, and so the drain has gone on for years, very greatly to our disadvantage.

Recently a well-known leader in the labour world said that he had worked for 16 years in English engine and machine shops, and in the whole of that time saw less friendly consultation between employers and employed than he saw during 16 weeks' work in an American shop. It is the practice of the American firms to secure a highly skilled group of men, whom they pay well and keep with them, and this latter feature especially has been a most important factor in the progress they have made. Whilst the Americans are ever ready to receive and act upon suggestions from however humble an employé, with us a man stands a good chance of losing his situation if he ventures to criticise at all frankly. Frequently where a really valuable improvement has been suggested, the man making it has been cold shouldered out of the firm by a well-known system somewhat akin to boycott, and when the idea has been put into use, some official has unblushingly taken the credit.

It is a common saying that no man can consider himself indispensable, and yet there are not so many really sound experienced engineers available that it is wise to treat them as though they can be replaced at a moment's notice. Nothing racks a place up so much as constantly changing the staff, and this is especially the case in the designing department, because so much valuable information can be, and is, carried in the head. The most perfect system of keeping written records does not stand a chance against a man's memory, especially where the work is hurried through, as it generally is in these days. Take the case of where a customer has called and certain drawings are required for his immediate inspection. If the man who has had the work in hand is available he will generally go straight to the drawers and get out the drawings in less time than the numbers can be found in the Drawings Register, however systematically such may be kept. Where the manager or other official has a weakness for making alterations, the disorganisation which may be caused by a trained assistant or a foreman leaving is naturally most serious, and especially is this so where practically the whole of the staff has been altered in a twelvemonth or so, due to changing an official, questions of salary, or some such cause. A competent manager must not only be able to choose capable assistants, but also be able to keep them. Blustering, bully ragging, and undue favouritism will not do nowadays.

## THE DOWNFALL OF THE ATOMIC THEORY.

At the beginning of the present century Dalton laid the foundation of the atomic theory of chemistry. The belief in the chemical atom has become more firmly established by the physical and chemical investigations of the century, and this atom has till recently successfully resisted all assaults on its indivisibility. But the remarkable paper read by Prof. J. J. Thomson at the last meeting of the British Association, and published in the December number of the *Philosophical Magazine*, puts forward evidence which makes it almost impossible to doubt that the atom of the chemists can no longer be looked upon as the smallest indivisible particle of matter, but is actually split up into very much smaller particles in certain well known physical processes. If this theory is firmly established it will revolutionise the 19th century views on chemical and electrical theory, which by their total failure to explain the phenomena of the recently discovered Röntgen rays and of electric discharge in rarefied gases, had begun to prove themselves effete.

Faraday was the first to show that the quantity of a given metal deposited in an electrolytic cell was proportional to the quantity of electricity which passed through the solution. This quantity of metal is also proportional to the atomic weight of the metal divided by its valency, *i.e.*, the number of chemical bonds set free by the decomposition of the molecule. In the form given to it by Helmholtz, Faraday's law states that *the same quantity of electricity passing through an electrolyte either sets free, or transfers to other combinations, always the same number of valencies.* In his Faraday lecture delivered in London in 1881, he made the following important induction from Faraday's law: *Every single valency of an elementary or compound ion is charged with exactly the same quantity of positive or negative electricity which behaves as if it were an electric atom that cannot be further divided.* This amounts to saying that every active chemical bond of a chemical element is associated with the same constant quantity of electricity.

Prof. J. J. Thomson has extended the theory of Helmholtz by the remarkable discovery that when the elementary electric charge, or "electric atom," is negative, it is always associated with a small constant mass of matter, very much smaller than the atom of the chemists. These small masses or "corpuscles" with electric charges actually exist separately from the chemical atoms in the cathode rays, and in other cases where negative electricity is discharged through rarefied gases.

Prof. Thomson describes his remarkable hypothesis as follows: "I regard the atom as containing a large number of smaller bodies which I will call corpuscles; these corpuscles are equal to each other; the mass of a corpuscle is the mass of the negative ion in a gas at low pressure—*i.e.*, about $2 \times 10^{-26}$ of a gramme. In the normal atom this assemblage of corpuscles forms a system which is electrically neutral. Though the individual corpuscles behave like negative ions, yet when they are assembled in a neutral atom the negative effect is balanced by something which causes the space through which the corpuscles are spread to act as if it had a charge of positive electricity equal in amount to the sum of the negative charges on the corpuscles. Electrification of a gas I regard as due to the splitting up of some of the atoms of the gas, resulting in the detachment of a corpuscle from some of the atoms. The detached corpuscles behave like negative ions, each carrying a constant negative charge, which we shall call for brevity the unit charge; while the part of the atom left behind behaves like a positive ion with the unit positive charge and a mass large compared with that of the negative ion. On this view electrification essentially involves the splitting up of the atom, a part of the mass of the atom getting free and becoming detached from the original atom."

This remarkable theory will modify our ways of looking at many electrical phenomena. In electrolysis, for instance,

when the anions and cations are liberated against the electrodes, the ions with the positive charge are minus the negative corpuscle and are neutralised by a corpuscle moving from the electrode to the ion, while the ions with the negative charge are neutralised by a corpuscle passing from the ion to the electrode. The corpuscles according to this view are the vehicles by which negative electricity is carried from one atom to another. It would appear that there is only one kind of electricity, namely, negative; positive electricity being due to the atom being short of negative corpuscles.

What takes place in the electrolysis of a solution of hydrochloric acid may be illustrated by the diagram, fig. 1, in which A represents the anode and K the cathode of the

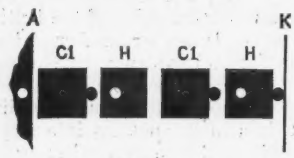


Fig. 1.

electrolytic cell. The effect of solution upon an electrolyte is, according to Arrhenius, to dissociate the molecules, *i.e.*, the chemical bond which unites the two atoms forming the molecule is torn asunder. This chemical bond, according to the theory we are now considering, is the negatively charged corpuscle. This bond, for some reason not understood, adheres to the electro-negative atom, and leaves a corresponding empty space in the electro-positive atom. This circumstance makes the chlorine negative and the hydrogen positive. The negative electric charge on the cathode means an accumulation of electric corpuscles on its surface, while the positive charge on the anode means an accumulation of corpuscle cavities near its surface. The result is, that hydrogen is attracted to the cathode, and chlorine to the anode, but the transference of electricity is due to the passage of corpuscles from atom to atom throughout the electrolyte. Conduction in metallic conductors probably takes place in the same way, but as the corpuscle has no greater attraction for one set of atoms more than another, there is no transference of the normal atoms along the conductors. In dielectrics, something prevents the corpuscles being transferred from one atom to another.

The number of corpuscles which can be detached from an atom by any known process is never greater than its valency or the number of its chemical bonds. It does not, however, follow that the part left behind does not contain more corpuscles which might be detached by more powerful means. The Zeeman effect, in which the lines of the spectrum are split up by the action of a magnetic field on the luminous substance, is explained by assuming that rotating particles of the substance, having an electric charge, are accelerated or retarded by the force exerted on these charged particles by the magnetic field. The ratio of the mass to the charge as determined by this effect is of the same order as that which has been deduced for the corpuscles, and hence the vibrating particles which produce the lines of the spectrum are probably the corpuscles of the atom. This view is further confirmed by the fact that the explanation of the Zeeman effect requires that the particles be *negatively* electrified. Now there are a considerable number of lines in the spectrum which show the Zeeman effect, and the presumption is that there are a considerable number of corpuscles in the atom of the substance giving this effect.

The ingenious experiments by which Prof. Thomson proves the existence of negatively charged corpuscles with a mass very much smaller than that of the smallest chemical atom, will be found fully described in his paper in the *Philosophical Magazine*. We propose here merely to briefly describe the nature of these experiments. Prof. Thomson had previously determined (*Phil. Mag.*, October, 1897) the value of the ratio of the mass, $m$, of the ion to its charge, $e$, in the case of the stream of negative electrification which constitutes the cathode rays. The results of this determination which were confirmed by subsequent determinations by Lenard and Kaufmann, showed that the value of this ratio was very much less than that of the corresponding ratio in the electrolysis of solutions of acids and salts, and that it was independent of the nature of the gas through which the discharge passed and of the nature of the electrodes. Of course, the smaller value of $m/e$ in the cathode rays might be due either to the mass of the particles being smaller, or to the electric charge on each being greater.

As it did not appear feasible to determine $m$ or $e$ separately in the case of cathode rays, experiments were made on a similar phenomenon, namely, the discharge of negative electricity from a metal plate under the influence of ultra-violet light. Elster and Geitel have shown that the rate of escape of negative electrification at low pressures is much diminished by a magnetic field when the lines of magnetic force are at right angles to the lines of electric force. In this case a negatively electrified particle detached from an electrified plate by the action of ultra-violet light, is acted upon by two forces, namely, the electric force normal to the surface of the plate, and an electro-magnetic force which is always normal to the direction in which the particle is moving. The effect of the magnetic field is to cause the particle to follow a curved path, like a projectile, and come back to the surface of the plate from which it started. The path is not, as in the case of the projectile, a parabola, but a cycloid, as the following demonstration shows.

If $m$ is the mass of the particle, $e$ its charge, X the electric force, H the magnetic force, the equations of motion are:—

$$m\frac{d^2x}{dt^2} = \mathrm{X}\,e - \mathrm{H}\,e\frac{dy}{dt}$$

$$m\frac{d^2y}{dt^2} = \mathrm{H}\,e\frac{dx}{dt}$$

Eliminating $x$, we have

$$m\frac{d^3y}{dt^3} = \frac{\mathrm{H}\,e}{m}\left(\mathrm{X}\,e - \mathrm{H}\,e\frac{dy}{dt}\right).$$

The solution of these equations, if $x$, $y$, $\frac{dx}{dt}$, $\frac{dy}{dt}$ all vanish when $t = 0$, is expressed by

$$y = \frac{\mathrm{X}\,m}{e\,\mathrm{H}^2}\left\{\frac{e}{m}\mathrm{H}\,t - \sin\left(\frac{e}{m}\mathrm{H}\,t\right)\right\}$$

$$x = \frac{\mathrm{X}\,m}{e\,\mathrm{H}^2}\left\{1 - \cos\left(\frac{e}{m}\mathrm{H}\,t\right)\right\}$$

These equations show that the path of the particle is a cycloid, the generating circle of which has a diameter equal to $2\,\mathrm{X}\,m/e\,\mathrm{H}^2$.

The diameter of this circle is the extreme distance from the electrified plate reached by the particles. Its diameter can be determined experimental by gradually moving a receiving plate away from the discharging plate till the former plate begins to receive less electricity than the latter plate discharges. This diameter having been determined, and X and H being known, the value of $m/e$ can be readily found. It was found by Thomson to be of the same order as for the cathode rays. The value found for $e/m$ was $7\,3 \times 10^6$; for cathode rays the value found by Thomson was $5 \times 10^6$, and by Lenard $6{\cdot}4 \times 10^6$.

The value of the ratio, $m/e$, having been determined, all that was now necessary was to determine the value of the electric charge, $e$, on the particles liberated by the action of ultra-violet light.

Wilson (*Phil. Trans.*, 1898) had discovered that ions produced by ultra-violet light from nuclei, around which water will condense. If we wish to find the number of ions produced by ultra-violet light in a cubic centimetre of air, we cool the air by sudden expansion until the supersaturation produced by the cooling is sufficient to form a cloud round the ions. The problem is now reduced to counting the number of drops per cubic centimetre. This can evidently be done if we know the quantity of water per cubic centimetre and the size of the drops. From the amount of expansion we can calculate the number of drops. The size of the drops can be determined from the rate, $v$, at which they fall, by means of the equation

$$v = \frac{2\,g\,a^2}{9\,\mu}$$

where $a$ is the radius of the drop, and $\mu$ is the coefficient of viscosity of the gas, through which the drop falls.

In this way, $n$, the number of ions per cubic centimetre

is determined. If $e$ is the charge on an ion, $u$, the velocity with which it moves under a known electric force, the quantity of electricity which crosses unit area in unit time under this force is $n, e, u$. The value of $u$ has been determined experimentally; hence the value of $e$ can be easily calculated.

The mean value of $e$ found in this way by Prof. Thomson was $6\,8 \times 10^{-10}$; we must refer our readers to the original paper for the details of the experiments. This value approximate very closely to the value of $e$ on the hydrogen ion in electrolysis. It follows from this that $m$, the mass of the particle carrying the negative charge in the beam of cathode rays is exceedingly small, being only about $1{\cdot}4 \times 10^{-3}$ of the hydrogen ion. This mass is constant for all gases. It is this corpuscle which is detached from the atom by the action of ultra-violet light, and by the heat of an incandescent carbon filament.

This theory of Prof. Thomson's throws light on a great many phenomena otherwise difficult or impossible to explain. Take, for example, the Phillips effect (ELECTRICAL REVIEW, Vol. 45, p. 462). In this experiment, after the gas in a tube has been dissociated by an electrical discharge, a negatively electrified luminous ring rotating round the lines of force is produced by a varying magnetic field. The negative corpuscles being of much smaller mass than the positive ions, are much more easily set in motion by the electro-magnetic forces, and hence the negative electrification of the ring.

The electrification of air by the splashing of drops of water which has been so thoroughly investigated by Lenard may find its explanation in this theory. The negative corpuscle attached to the atoms of oxygen is probably separated from the atom by the solution of the air in water, so that the mere mechanical shattering of the drop is sufficient to set free the corpuscle with its negative charge. The electrification developed in this way is always negative unless a certain percentage of salts is dissolved in the water, when the electrification is positive. Evidently in the latter case some of the atoms of these salts retain the negative corpuscle and set free its positive atomic partner. The whole obscure question of the origin of atmospheric electricity will probably receive considerable elucidation from the electric corpuscle theory.

The evidence on which Thomson's theory is founded is so strong that it will be hard to upset; and if it stands, there can be little doubt that it is the beginning of a new era in chemistry and molecular physics.

## REVIEWS.

*The Engineers' Year-Book of Engineering Formulæ, Rules, Tables, Data, and Memoranda.* By H. R. KEMPE, A.M.Inst.C.E. London: Crosby Lockwood & Co. 1900.

With the seventh year of publication, this capacious volume appears with 768 pages, and quite a quantity of new matter, and many revisions to bring the various sections to date. Then there are additions to the section on superheaters and feed heaters, and a considerable addition to the section on water-tube boilers, several of which are now illustrated. We observe that the illustrations of the Durr and the Haythorn boilers are, however, wrongly named, the one for the other, so that the letter press refers to the wrong illustration. Sight-feed lubricators and oil filters now find some space in the book.

A very poor illustration in previous editions of a locomotive type boiler has been replaced by an illustration of a Robey boiler of modern make, and by a boiler of the Great Northern Railway Company. Five distinct types of water-tube boiler are illustrated, besides two types of small tube boiler, Thorneycroft and Yarrow.

There is little or no change in the electrical section. One or two slight errors have crept in due to the entire repaging of the book, a reference on page 537 to page 483 should have been 560 for example.

In the railroad or, rather, locomotive section, there are considerable additions in the shape of schedules of dimensions of the engines of the Great Central and of the American engines on the Midland Railway.

There is also introduced a short notice with a few figures of tests of roller bearings.

The section on the physical properties of the more important simple and compound gases has been greatly extended with a view to its utility in gas engine and similar computations, but we notice that "hydrogen has not been solidified yet." It has, we believe, been solidified, but only quite recently by Dewar.

The excellent logarithmic and other tables and general rules and data of a permanent order are retained in the earlier part of the volume unchanged.

The book is, in fact, quite an encyclopædia of civil and mechanical engineering. There are few branches not represented, and by annual revision the book is kept up to date very closely, and time-expired matter expunged to make room for new.

*Mechanical World Pocket Diary and Year-Book for 1900.* Manchester: Emmott & Co., Limited.

The thirteenth annual issue of this well-known and excellent handbook has been further extended by the addition of over 40 pages, including a section on electrical transmission of power and various new tables. The sections on indicator diagrams and wheel gearing are capital; and a handy system of taking out weights of materials is introduced. We cordially recommend the book to practical engineers.

*The Practical Electrician's Pocket-Book for 1900.* Edited by H. T. CREWE, M.I.M.E. London: S. Rentell & Co., Limited.

This handy little book, which made its first appearance last year, has been revised and improved; it is a real pocket-book, unlike many so-called, and contains, in addition to a diary, a number of pages for memoranda, detachable printed forms for estimates and requisitions, and sectional paper. The first nine pages are devoted to extolling the advantages of electricity in various applications, and are somewhat superfluous; they are followed by definitions of electrical terms, the looseness of which cannot be justified by describing them as elementary. For instance, the watt is said to be a unit of "power or energy," and a Board of Trade unit to be 1,000 "watts per hour." Sections on prime motors of various descriptions, belts, ropes, &c., follow; and the remainder of the space is devoted to electrical apparatus. Useful hints on dynamo-tending, wiring with casing, conduit and other systems, jointing, and general installation work are included, with many short sections on special subjects; the principal feature of the book, in fact, is the preponderance of text over tables, contrary to the usual run of pocket-books. We regret, however, to find that it contains no index—only a table of contents. A pocket-book without an index is like Hamlet without the prince. We trust that this grave defect may be remedied in future editions.

## NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

### NEW PATENTS.—1900.

Compiled expressly for this journal by W. P. THOMPSON & Co. Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester and Birmingham, to whom all inquiries should be addressed.

2,734. "Improvements in apparatus for signalling the approach of electric trams operated on the overhead system." W. R. STEARNS. Dated February 12th.

2,742. "Improvements in apparatus for firing submarine mines by means of Marconi's wireless telegraphy." F. MAYLANDER. Dated February 12th. (Complete.)

2,755. "Improvements in collectors for electric trams on the overhead system." G. W. BOLSER. Dated February 12th.

2,767. "Improvements in long distance relay magnetic telephones." J. NESSEL and J. F. GOUIN. Dated February 13th. (Complete.)

2,783. "Improvements in electrical arc furnaces." J. Y. JOHNSON. (The Deutsche Gold and Silber Scheide Anstalt vorm. Roessler & Birger Carlson, Germany.) Dated February 12th.

2,797. "Improved telephonic receiver for messages sent by means of electro-magnetic oscillations and signs of the Morse alphabet." A. S. Popov. Dated February 12th. (Complete.)

2,842. "Improvements in and relating to thermostatic circuit controlling apparatus." A. G. Brookes. (E. F. Woodman and H. A. Fiske, United States.) Dated February 13th. (Complete.)

2,843. "Improvements in clips or devices for holding electric lamps or the like." R. Hacking. Dated February 13th.

2,850. "An improved device for adjusting the height of electric lamps or fittings. C. K. Falkenstein. Dated February 13th.

2,862. "Improvements in electric traction motors." C. Richter and R. T. Eschler. Dated February 13th. (Complete.)

2,880. "Improved system of and means for regulating electric machines." W. H. Cooley. Dated February 13th.

2,897. "Improvements relating to electric railways." W. Chapman. Dated February 13th.

2,929. "Improvements in electrolysers." W. T. Chapman and W. E. Batt. Dated February 14th.

2,948. "Improvements relating to fuels for electric circuits." G. W. Holt, of the Imperial Electrical Engineering and Stamping Company. Dated February 14th.

2,951. "Improvements in the methods of insulating electrical conductors." J. F. Wakelin, C. J. Weston, and W. Bunn. Dated February 14th.

2,952. "Improvements in the methods of insulating and fixing electrical conductors." J. F. Wakelin, C. J. Weston, and W. Bunn. Dated February 14th.

2,994. "An improved process for the electrolytic deposition of nickel or its allied metals." M. Kugel. Dated February 14th.

3,013. "Electrical displacement switch." J. Cusworth. Dated February 15th.

3,021. "The automatic trolley pole arrester for electric tramcars." J. T. Hale and F. G. Hale. Dated February 15th.

3,031. "Improvements in electricity meters." C. W. G. Little. Dated February 15th.

3,033. "Improvements in and connected with electric accumulator plates or electrodes." F. L. Berners and J. A. Smith. Dated February 15th.

3,043. "Improvements in voltmeters and ammeters." C. Raab. Dated February 15th.

3,056. "Improvements in electric meters." V. I. Feeny. (Allgemeine Elektricitäts, Germany.) Dated February 15th. (Complete.)

3,068. "An improved method of controlling trolleys of electric cars." R. A. Bolton. Dated February 16th.

3,081. "Improvements in electrical apparatus for signalling from passengers in a moving train to the engine driver and guard." A. E. Radbourne. Dated February 16th.

3,104. "Improvements in magnetic locking devices for miners' lamps." F. Muller and F. Eumes. Dated February 16th. (Complete.)

3,105. "Improvements in systems of electrical distribution and safety apparatus therefor." L. C. Reed, W. B. Reed, and E. H. Farrar. Dated February 16th. (Complete.)

3,106. "An automatic electric circuit breaker." L. C. Reed, W. B. Reed, and E. H. Farrar. Dated February 16th. (Complete.)

3,107. "An improvement in isolated alternating low tension systems of electrical distribution." L. C. Reed, W. B. Reed, and E. H. Farrar. Dated February 16th. (Complete.)

3,108. "Improvements in arc lamps." W. C. Johnson and A. Wunderlich. Dated February 16th.

3,120. "Improvement in means for regulating pressure in electric mains." H. W. Butler. Dated February 16th.

3,124. "Methods of and apparatus for manufacturing movable coils for use in connection with electrical measuring instruments." E. Weston. Dated February 16th. (Complete.)

3,143. "Improvements in or relating to electric relays." E. W. Brown. Dated February 16th.

3,144. "Improvements in or relating to telephones." E. W. Brown. Dated February 16th.

3,145. "Improvements in or relating to telegraphic instruments." E. W. Brown. Dated February 16th.

3,150. "Improvements in trolley poles and standards for electric traction." R. P. Strachan. Dated February 16th.

3,158. "Improvements in and relating to fluid pressure thermo-dynamic engines." J. T. Wainwright. Dated February 16th.

3,174. "Improvements in and connected with long-distance telephony." M. C. Mengis. Dated February 17th. (Complete.)

3,192. "Electric battery, and its arrangement in connection with electric motor cars." A. de Castro and H. W. Schlomann. Dated February 17th. (Complete.)

3,196. "A new or improved telegraphic apparatus." L. Wojniewicz. Dated February 17th. (Complete.)

3,200. "Improvements in and in the process of manufacturing filaments for electric incandescence lamps." V. Thomas. Dated February 17th. (Date applied for under Patents, &c., Act, 1883, Sec. 103, August 8th, 1899, being date o fapplication in France.)

3,203. "Improvements in interrupters for electric circuits." J. Lecarme and L. Lecarme. Dated February 17th. (Complete.)

## ELECTRICAL PATENTS OF 1886 EXPIRING IN MARCH, 1900.

We are informed by W. P. Thompson & Co. that about 100 electrical patents were filed in March, 1886, of these some were never completed, and of those that were only one has been maintained to run its full term, viz., 14 years, and being of considerable interest we give a short abstract of it below:—

**2,975. "Improvements in dynamo-electric machines." N. Tesla.** Dated March 2nd, 1886. Relates to the regulation of dynamos. An extra brush or pair of brushes is used in connection with the field circuit, bearing at points on the commutator intermediate between the main brushes, whereby the currents passing through the field coils are varied as required either automatically or by hand. The commutator of a shunt-wound machine is provided with two main brushes. A conductor is led from the field coils to the extra brush on the commutator. For a particular position of the extra brush the potentials at the extra brush and the point in the field coils from which the conductor is led to it, will be equal; if the brush is shifted in either direction the poles of the field magnets will be shifted; or, if the magnets are differentially wound, altering the strength of the field. The invention is similarly applicable to series-wound machines, conductors being led from suitable points in the field winding to the extra brush or brushes, so as to vary the currents passing through the coils. The extra brush or brushes may be moved by a solenoid, the core of which is connected with their holders; both main and extra brushes may be moved simultaneously in opposite directions. 2 claims.

## ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

**23,489. "Improvements in electric storage cells." C. P. Ellison.** Dated October 19th, 1897. Accumulator plates are built up of several layers of thin perforated and corrugated sheet lead, the successive sheets having the corrugations at right-angles to one another. An outer sheet of the same material is wrapped round the plates, and its ends are folded together and burned. Strips of lead are burned on at the top and bottom of the plate, and lead rivets are also burned in to hold the whole together. The completed plate is rolled or pressed to reduce projecting parts, &c. "Forming" is effected by the Planté process, the exterior being protected by varnish, subsequently removed, to ensure proper formation in the interior. 3 claims.

**23,513. "Improvements in telephone receivers and the like." G. A. Nussbaum. (La Societe Industrielle des Telephones.)** Dated October 13th, 1897. A pair of telephones are mounted on a spring by means of ball and socket joints and position springs. The spring is mounted on an aluminium handle through which a flexible lead passes. The spring may be provided with a regulating screw for controlling the space between the telephones. 1 claim.

**23,514. "Improvements in or relating to electric tramways or railways." J. McKenny and A. E. Porte.** Dated October 13th, 1897. Electric railways and tramways on a road-contact system with electro-magnetic switches. Conductors, switches.—The circuit between the main conductor and the stud from which the vehicle is supplied with current is completed by a wedge bridging the contacts. The wedge is attached to the core of a solenoid excited by current from the vehicle passing through it by a stud to earth. One contact is pivoted and the other mounted on a link so as to give a rubbing-contact with the wedge; the studs are placed diagonally with regard to the rails. The mechanism is fixed on an insulating slab attached to the cover of the box, and spring contacts are used to allow ready removal. 6 claims.

**23,623. "An improved process of manufacturing electric incandescent lamps." C. Howard and Dr. R. Mayer.** Dated October 13th, 1897. Incandescent lamps. The bulb is attached to a long neck which may be divided and fused or otherwise connected together again without damage to the cap. The filament is fixed on two straight wires of platinum or nickel, connected by a piece of glass. These wires are attached to the leading-in wires by tight-fitting sleeves of thin copper tube or of helically-coiled wire; or the wires may be placed side by side in oval sleeves, and fixed by pushing tapered pins transversely between them, through holes in the sleeves: or they may be held together by blocks connected by screws or rivets. A damaged filament may thus be readily replaced. A screw cap fits against a shoulder on the neck, and has slots to receive projections thereon. It is secured, without cement, by a band or wire wound round it between the shoulder and projections, to compress it on the neck. The provisional specification mentions connection of the wires by soldering. 3 claims.

**23,625. "An electrical time switch." A. J. Wheatley, J. M. James, and T. B. Browne.** Dated October 13th, 1897. Relates to a switch in which a cam mechanism is operated to make or break contact at predetermined times by a clock or other timing apparatus. A spindle is driven by suitable gearing from a clock and gears with cam-wheels running loosely on a spindle. The cams have recesses or inclined planes and press against pins which may be fixed in any position by turning the spindles. Wires or rods pivoted are separately adapted at their lower ends to operate a switch arm when the upper ends are moved by one of the cam recesses coming opposite one of the pins. For switches adapted only to make, or to break, only one cam and adjusting spindle are required. 2 claims.

**23,681. "Improved mechanism for operating or controlling electrical motors at a distance." C. Martinez.** Dated October 14th, 1897. Relates to switch apparatus for controlling motors at a distance and for indicating when the movement has been made. The motor may operate a steam valve, steering gear, or the like. Within a casing at the top of the controller are two pointers, the former of which records the displacement of the operating wheel, and the latter indicates the position of the motor. The movements of the wheel is transmitted through gear wheels, one wheel being loosely mounted on a shaft on which are also mounted two springs wound in opposite directions. Each spring barrel has an extension engaging a pin depending from the wheel. Any movement of the wheel thus puts tension on one or other of the springs. The movement of the shaft indicated by the pointer is controlled by an escapement wheel, with which engages a hammer operated by an electro-magnet. A make or break of the current through the magnet will allow the escapement wheel to move one tooth, and thus allow the shaft to rotate. The distant motor operates a make-and-break switch to control the magnet. A current to the motor, or to the relay, is sent when the wheel is turned by the following means:—The shaft carries a fork supporting a spindle, having a wheel which has a single tooth taking in a recess in the wheel, and also an eccentric adapted to raise or lower, according to the direction of motion of the wheel. Hand switches may be fitted for completing the circuits. The motor may directly control a helm for steering purposes, or may control a steam valve. The switch preferably operates through a double relay. Reference is made to the electro-magnetic switches described in Specifications Nos. 11,594 and 11,594a, A.D. 1897. 1 claim.

**23,705. "Improvements in electric motor engines." C. B. Callow.** Dated October 14th, 1897. Motors, controlling.—Two motors are combined in one, the field magnet and armature each having two separate windings, which are connected to the contact plates of a controlling switch. This switch is so arranged that the field windings may be placed in parallel, and the armature windings in series with the field windings, so as to obtain full speed, or all the windings may be placed in series for half speed. An intermediate speed may be obtained by putting the fields in series and the armatures in parallel. 2 claims.

**23,792. "Improvements relating to the electric propulsion of vehicles." F. W. Schneider.** Dated October 15th, 1897. Electric railways and tramways worked with accumulators alone or with a mixed system of conductors and accumulators. A small auxiliary battery constructed for quick discharge supplements the main battery at starting. 1 claim.

**23,988. "Improvements in apparatus especially suitable for grinding and polishing the commutators of electrical apparatus." H. H. Perry.** Dated October 18th, 1897. Commutators, grinding and polishing. An emery wheel mounted on a shaft is carried by a framework which may be temporarily fixed to the bedplate or to the pedestal of the dynamo or motor. The emery wheel may be driven from the shaft of the dynamo by a belt, or by an auxiliary motor through a belt. One of the bearings of the shaft is pivoted on a vertical axis, and the other is mounted on a slide rest, by means of which the grinding wheel may be fed towards the commutator surface or traversed along it. 4 claims.

**24,051. "Improvements in electrodes for primary and secondary batteries in chemical cells." R. Fabian.** Dated October 19th, 1897. Electrodes are made up of a number of concentric spherical metal sheets, each made in two parts mounted on an insulating stem, and separated by insulating nuts. The sheets are alternately positive and negative, and the sheets of the same polarity are connected by pieces to binding posts. Holes allow the circulation of the electrolyte. 2 claims.

**26,343. "Improved methods of and apparatus for manufacturing filaments for electric lamps." H. S. Maxim.** Dated November 11th, 1897. Relates to incandescent lamps. Filaments of high resistances are made from finely powdered materials containing carbon, which has been subjected to a very high temperature and pressure, so as to be converted into a badly conducting modification resembling diamond. The powdered materials are mixed with tar, sugar, or the like, moulded, carbonised, and flashed as usual. The provisional specification mentions the admixture of anhydrous boracic acid with the carbon, to produce a carbide, or of pumice stone and carbide of silicon. In a modification, carbon filaments which have been carbonised as usual are similarly heated, under pressure, in a hollow carbon conductor. One form of arc furnace for producing such diamond like carbon is also described. 5 claims.

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| **PROVINCIAL.** | | | | | | |
| (1) **Aberdeen** | Corporation | 3 wire at 220 and 440 v. | 8 water tube B. & W. | 2 (Willans) 38 h.p., 3 do. 80 h.p., 2 do. 200 h.p., 2 do. 300 h.p., 1 (Belliss) 650 i.h.p. | E.C.C., Holmes, Crompton, Bruce Peebles, Mather and Platt | 2 23 kw 2 120 k 1 390 k |
| (2) **Alderley and Wilmslow** | Electric Light Co. | 3 wire | 2 Davey-Paxman loco. type | 2 (Belliss) 75 h.p., 550 revs. | Ediswan 2 pole under type.. | 46 kw. |
| (3) **Ashton-under-Lyne** | Corporation | 3 wire | 4 Lancs., 2 multitubular | 3 (Browett-Lindley) inverted enclosed type of 500 h.p. each | 3 bi-polars, P. R. Jackson's, with Sayers winding | 300 kw. |
| (4) **Belfast** | Corporation | 3 wire | 6 Lanc., 2 water tube | 2 60 h.p. gas engines, 4 120 do.; 2 (Belliss) 175 h.p., 2 do. 350 h.p., 4 do. 700 h.p. | 2 pole under-type; 6 2 pole, 4 multi-polar | 2 26 kw 2 200 kw., 4 |
| (5) **Bilston** | Urban District Council | 2 wire | 2 loco., 1 Cornish | 2 37 h.p., 1 50 h.p. | Brush, Paterson and Cooper and E.C.C. | 1 12 kw 1 18 kw |
| (6) **Birkenhead** | Corporation | 3 wire at 460 and 230 v. | 3 Lanc. | 3 (Willans) 80 i.h.p., 2 (Willans) 240 i.h.p. | Crompton and Siemens | 3 50 kw. |
| (7) **Birmingham** | Corporation | 3 wire | Lanc. | Willans and Belliss | Crompton and E.C.C. | |
| (8) **Blackburn*** | Corporation | 3 wire con. cen. area, 3 & 2 wire alternating to outer districts | 6 Lanc. | 2 (Willans) 80 h.p., 2 do. 100 h.p., 2 do. 200 h.p., 1 do. 360 h.p., 2 (Belliss) 250 h.p., 1 do. 360 h.p., 1 do. 770 h.p. | Siemens, Mather and Platt and E.C.C. | 2 45 kw., 150 kw., 500 kw. c 1 200 kw |
| (9) **Bolton** | Corporation | 3 wire | 9 Lanc. | 2 (Musgrave) 1,000 h.p., 2 do. 500 h.p. | Mather and Platt 12 pole | 2 600 kw |
| (10) **Bootle** | Town Council | 3 wire | Lanc. | 2 (Belliss) 125 h.p., 3 do. 250 h.p. | Parker | 2 75 kw |
| (11) **Bradford** | Corporation | 3 wire at 460 and 230 v. | — | Willans | Siemens | 80 to 380 |
| (12) **Brighouse** | Corporation | 2 wire | — | Gas engines, 1 7 h.p., 1 14 h.p., 1 20 h.p. nominal | Kapp | 1 7 kw., 1 16 kw |
| (13) **Brighton*** | Corporation | 3 wire L.T. contin., H.T. alt. with sub-stations | 6 Lanc., 8 B.W. water tube | 2 80 h.p. (Willans), 2 200 h.p. (Willans), 4 360 h.p. (Willans), 6 800 h.p. (Willans) | 6 multi-polar, 8 bi-polar | 2 45 kw., 4 220 kw. |
| (14) **Bromley (Kent)** | Bromley Electric Light and Pwr. Co., Ltd. | 3 wire, & 2,000 v. to supply Chislehurst | 3 Dy-Pxmn. economic | 2 (Belliss) e.c./6, 1 (Belliss) t.e.c./3 | Parker 2 pole | 2 84 kw. |
| (15) **Buckingham** | Buckingham Elec. Lgt. and Pwr. Sup. Co. | 2 wire | Cochrane semi-port., Marshall | 1 horizontal, 1 semi-portable, 40 h.p. and 24 h.p. | Elwell - Parker, Goolden, Greenwood and Batley | 2 9 kw., 40 kw. |
| (16) **Burnley** | Corporation | 3 wire | 3 Lanc. | 2 120 h.p., 1 250 h.p. horizontal, 2 450 h.p. vertical (Belliss) | Elwell-Parker and E.C.C. | 2 90 kw., 2 140 k |
| (17) **Bury** | Corporation | 3 wire | 3 Lanc. | 2 (Belliss) 210 h.p., 1 (Belliss) 360 b.h.p. | 2 pole shunt wound | 2 130 kw. |
| (18) **Canterbury** | Town Council | 3 wire | 3 Lanc. | 2 125 b.h.p., 1 250 b.h.p. | India-rubber & Gutta Percha Co. | 4 38 kw., |
| (19) **Carlisle** | Corporation | 3 wire | 3 Lanc. | 2 (Willans) 100 i.h.p., 2 do. 200 i.h.p. | Siemens bi-polar | 4 30 kw., |
| (20) **Chester** | Corporation | 3 wire 420 v. | 5 water tube | 3 (Belliss) 150 h.p., 2 (Belliss) 450 h.p. | Parker | 3 80 kw., |
| (21) **Chislehurst** | Chislehurst Electric Supply Co., Ltd. | 3 wire | (supplied with 2,000 volts continuous current from Bromley) | | Parker | 2 40 kw. |
| (22) **Colchester** | Town Council | 3 wire at 210 volts across outers | 3 Paxman economic | 3 (Peache) 100 i.h.p. | Siemens 2 pole | 60 kw. |
| (23) **Cork** | Cork Electric Tramways & Lighting Co. | 3 wire | Babcock and Wilcox | 3 (Macintosh-Seymour) 300 h.p., 2 (Allis) 500 h.p. | Thomson-Houston traction | 3 235 kw., |
| (24) **Darwen (Lancs.** | Corporation | 3 wire at 460 volts | 2 Lanc. | 2 (Belliss) 250 h.p. | Siemens 2 pole | 150 kw. |
| (25) **Dewsbury** | Corporation | 3 wire 110 v., now changing to 220 v. | 3 Lanc. | 2 (Willans) 180, 1 (Willans) 80, 1 (Willans) 55, 1 (Willans) 250 | Crompton and Peebles | 2 100 kw., 1 30 kw., |
| (26) **Dundee** | Corporation | 3 wire 200 volts. | 8 Lanc. | 9 aggregating 1,226 h.p.; 2 450 h.p., 1 750 h.p. erecting | Siemens and Parker | 40 kw., 8 kw.; 30 kw. erect |
| (27) **Edinburgh*** | Corporation | Cont. cur. 3 wire, alt. cur,. isolated trans. | Marine and water tube | Willans 100 to 1,200 h.p. | 2 pole and multi-polar dynamos | 60 to 780 |
| (28) **Folkestone** | Folkstn. Electricity Supply Co., Ltd. | 3 wire | Paxman's economic | 2 (Peache) 120 h.p., 2 (Peache) 250 h.p. | Parker's direct current | 2 160 and 370 and 46 kw., 2,500 |
| (29) **Fort William** | Fort William Elec. Light Co. | 3 wire | — | 2 (Gilkes) turbines, 60 h.p. each, 1 (Gilkes) turbine, 40 h.p. | Laurence, Scott & Co., General Electric | 45 kw., 30 |
| (30) **Galway (Ireland)** | Galway Elec. Light Coy., Ltd. | 2 wire | Dowson gas producer | 2 75 h.p. (Hercules) turbines and 1 32 b.h.p. gas engine with Dowson gas plant | Statter and Crompton | Largest 2 smal |
| (31) **Glasgow** | Corporation | 3 wire | Marine and Babcock & Wilcox | 2 (Willans) 80 h.p., 2 do. 150 h.p., 3 do. 250 h.p., 6 do. 350 h.p., 1 (Ball-Wood) 750 h.p., 1 (M. Paul) 900 h.p., 1 (Mirrlees-Watson) 400 h.p., 1 do. 200 h.p., 1 (Alley-McLellan) 200 h.p., 2 (Belliss) 400 h.p., 2 do. 1,100 h.p. | Latimer Clark, Muirhead, Siemens, Walker, Schuckert, Crompton, Mavor and Coulson, British Thomson-Houston | 2 48 kw., 2 154 kw., 1 600 kw. 2 230 kw. 1 750 kw |
| (32) **Gorseinon** | Electric Light Co. | 2 wire | Vertical | 1 12 h.p. steam engine | Elwell and Parker | 22 kw. |
| (33) **Govan** | Corporation | 3 wire at 250 volts | Babcock and Wilcox | 2 (Belliss) 150 h.p. | British Thomson-Houston 6 pole, 500 to 600 volts | 95 kw. |
| (34) **Greenock** | Police Board | 3 wire | 2 Babcock and Wilcox | 1 (Belliss) 160 i.h.p., 2 do. 250 i.h.p. | Silvertown 2 pole, 2 shunt wound, 300 v., 2 compound, 600 v., 2 motor boosters | 2 50 kw. 2 150 kw. |
| (35) **Guildford†** | Guildford Electricity Supply Co. | 3 wire 400 v. | — | 3 40 i.h.p., 1 100 i.h.p. | — | 3 20 kw., 1 |
| (36) **Harrow-on-the-Hill** | Harrow Electric Light & Pwr. Co., Ltd. | 3 wire 440 and 220 v. | B. and W. water tube | Willans | Crompton | 3 60 kw., 1 |
| (37) **Hereford** | Town Council | 3 wire at 440 volts between outers | 2 Lanc (Meldrum's fcd. draught) | 2 (Belliss) 150 i.h.p. each | India-rubber & Gutta Percha Co. | 200 amps., each |
| (38) **High Wycombe** | W. (Boro) Electric Light & Pwr. Co., Ltd. | 3 wire | 3 Davey-Paxman's economic | 2 (Peache) 150 h.p. each, 1 (Peache) 250 h.p. | Parker | 2 72 kw., 1 |
| (39) **Hove** | Hove Electric Light Co. | 3 wire 220 v. | 2 Lanc., 4 water tube | 3 (Willans) 100 h.p., 2 do. 250 h.p., 2 do. 360 h.p., 1 do. 38 h.p., 1 (Belliss) 150 h.p. | Crompton | 3 60 kw., 1 90 kw., 2 1 23 kw. |
| (40) **Ingleton** | Company | 3 wire triple con. feeders, 3 core distrb. | — | 2 (Gilkes) vortex turbines, 16 to 20 h.p. | Hall | 35 to 45 a to 250 v. |
| (41) **Kelvinside** | Glasgow Corporation | 2 wire | 2 water tube | 2 (Willans) 125 h.p. | Goolden | 2 75 kw. |
| (42) **King's Lynn** | Council | 3 wire 400 v. across outers | 4 Dowson gas producers | 5 gas engines 65 b.h.p. each | 2 pole, 400 volts | 40 kw. |
| (43) **Lancaster** | Corporation | 3 wire | 3 Lanc. | 1 (Willans) 350 h.p., 1 (Willans) 200 h.p., 1 (Willans) 135 h.p., 1 (Willans) 60 h.p. | 3 Brush, 1 Mather and Platt | 1 120 kw., 1 36 kw., |
| (44) **Leamington** | Midland Elec. Light & Pwr Co., Ltd. | 2 wire | 3 Loco. | 2 horiz. 250 h.p., 1 horiz. 30 h.p. | Chamberlain and Hookham | 4 80 kw., 1 |
| (45) **Leith** | Town Council | 3 wire | 3 Lanc., 160 lbs. | 4 (Belliss) 150 h.p., 1 do. 100 h.p. | Silvertown horse-shoe 2 pole inverted machines | 4 92 kw., 1 |
| (46) **Leyton** | District Council | 3 wire 300 v. | 5 gas generators and 250 h.p. blrs. | 4 (Wells) gas engines, 60 b.h.p., 4 do. 85 b.h.p., 1 (Willans) 350 i.h.p. | Fuller-Wenström, E.C.C., General Electric Co., and Mather & Platt | 4 85 kw., 4 1 230 kw. |
| (47) **Lincoln** | Corporation | 3 wire, 460 v. | 4 Dryback, marine type | 3 (Willans) 80 i.h.p., 2 (Willans) 320 i.h.p. | Laurence, Scott & Co | 3 of 66 kw., kw. |
| (48) **Liverpool** | Corporation | 2 and 3 wire | Lanc. | Willans 300 h.p. and 1,200 h.p. | Siemens and E.C.C. | 160 kw. and |
| (49) **Llandudno** | Urban District Council | 3 wire 440 v. | Babcock, 2 comb. with dust destrc. | 2 150 h.p., 1 75 h.p. | Shunt wound | 2 100 kw., |
| (50) **Maerdy (Glamorganshire)** | — | 2 wire | Locomotive type | 1 (Robey) steam comp., 56 b.h.p. | Shunt-wound dynamo | 39 kw. |
| (51) **Manchester** | Corporation | 5 wire and 3 wire | 18 Lanc. 4 Babcock & Wilcox | 12 400 h.p., 2 2,500 h.p. | 12 bi-polar, 2 multi-polar | 12 250 kw., kw. |
| (52) **Mevagissey** | Mevagissey Electric Ltg Co., Ltd. | 2 wire | Loco. | Semi-portable 30 h.p. | Crompton | 26 kw. |

# List of Electricity Works of the Un

## PRESSURE CONTINUOUS CURRENT

| nerators. | Size of Generators. | System of Driving. | Condensing or Non-condensing. | System of Mains. | Number of Arc and Incandescents used in Private Lighting. | Number of Lamps used in Street Lighting, Arc and Incandescent. | Number of 8 C.P. Lamps added during past 12 months. | Price Charged to Private Consumers. | System of Charging. | Type of Meters Employed on Consumers' Premises. | Present actual Capacity of Works in kw. | Nature of Fuel used. | Total Cost of Construct-ing and Equipping Works. | Cost of Mains. | Annual Revenue per 8 C.P Lamp. | Number High Voltage used. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| s, Crompton, Mather and | 2 23 kw., 3 48 kw., 2 120 kw., 2 180 kw. 1 390 kw. | Direct .. | Non-condensing | Bare copper, Callender, B.I.W., and Siemens | 48,544 8 c.p. | 126 10 amp. arcs, 200 incandsnt. | 15,190 .. | 6d. and 8d. ltg., 3d. and 1d. power | Brighton | Ferranti, British Thomson-Houston | 1,180 kw. | Coal ..... | £65,000 | | — | Used exclus |
| under type.. | 46 kw. ..... | Direct .. | Non-condensing, Berryman feed water htr. used | Cllndr.'s fdrs. trpl. con. arm., ld. sh., Dis. 3 c.arm.ld.sh | — | — | 1,200.... | 7d. and 4d. | Brighton | Chamberlain-Hookham | 92 kw. | — | — | — | — | — |
| R. Jackson's, nding | 300 kw. each ..... | Direct .. | Condensing arrangements erecting | Concntrc. B.I.W., lead covd., drawn into Doult'n pipes | 71 arcs, 8,150 8 c.p. incandsnt. | 72 arcs, 160 incand. | — | 7d. first hour, 2d. after | Wright's | Chamb'lain-Hookh'm. and Wright's demand indicator | 900 kw. | Bolsover slack | — | — | — | — |
| pe; 6 2 pole, | 2 26 kw., 4 57 kw., 2 200 kw., 4 50 kw., 4 500 kw. | Rope and direct | Condensing.... | Bitumen cable in stonewarecasing, c.i. pipes & solid | 52,000 8 c.p. | — | 14,000 .. | Lgt, 7d. 1st hr., 2d. aft.; pr., 4d. 1st hr., 1½d. aft. | Wright's | Chamberlain-Hookham and Ferranti | 2,850 kw. | Gas, small Welsh and Eng. slack | — | — | — | All..... |
| and Cooper | 1 12 kw., 1 15 kw., 1 18 kw. | Rope.... | Non-condensing | Armoured ..... | — | 16 arcs .... | 120 .... | — | — | — | 45 kw. | Coal ..... | £3,000 | £200 | — | None .... |
| iemens .... | 3 50 kw., 2 150 kw. | Direct .. | Non-condensing | Callender's ..... | 98 arcs, 14,302 8 c.p. | 12 arcs, 10 incandsnt. | 5,537.... | 6d. ltg., 4d. pr., rebate to 3d. aft. 1½ hours | Discounts | Ferranti ..... | 450 kw. | Slack .... | — | — | — | All .... |
| .C.C..... | — | Direct .. | Non-condensing | Bare copper and Callender's, in c.i. conduits | 125,400 8 c.p. lamps | None..... | — | 7d. | Sliding scale | Hookham and Ferranti | — | — | — | — | — | — |
| r and Platt | 2 45 kw., 2 120 kw., 2 150 kw., 1 225 kw., 1 500 kw. con.; 2 60 kw., 1 200 kw. alternating | Direct .. | Part condensing | L.T. rub. in c.i. conduits, alterng. feed. con. arm'rd | 22,793 .... | 76 arcs, 239 incand. | — | 6d. and 3d. ltg., 2½d. and 1½d. power | Brighton | Hookham, Ferranti, and Thomson | 1,675 kw. | Slack .... | £51,553 | £29,882 | 5/10 | Used on skirts of area |
| t 12 pole .. | 2 600 kw., 2 300 kw. | Direct .. | Both..... | Triple concentric paper, B.I.W. | — | — | — | — | — | Ferranti ..... | 1,800 kw. | Slack .... | £45,000 | £5,000 (feeders) | — | — |
| ..... | 2 75 kw., 3 150 kw. | Direct .. | Condensing.... | B.I.W..... | 8,588 8 c.p. | 36 arcs, 72 incandsnt. | — | 5d. and 3d. lt., 5d. & 1½d. pr. | Wright's | Chamberlain-Hookham | — | Burgie .... | — | — | — | — |
| ..... | 80 to 380 kw. ..... | Direct .. | Condensing.... | Feeders armoured dist. arm'rd, laid in ground | 746 arcs, 74,300 8 c.p. | 51 arcs, 35 incandsnt. | 14,300 in., 1,885 arcs, 21,489 mts. | 4½d. ltg., 2d. intermtnt. pr., 1d. cont. pwr. | 2½ discnt. and free lamps. | Thomson, Hkham., Ferranti, Bastian, Brillié, and Aron | 2,769 kw. | Coal ..... | — | — | — | Used throu |
| ..... | 1 7 kw., 1 13 kw., 1 16 kw. | Belt .... | — | Overhead..... | 20 arcs, 1,000 8 c.p. | — | 160 .... | 6d. | Meter .. | Chamb'lain-Hookham, Ferranti, and Bastian | 36 kw. | Gas ..... | £2,000 | | 8/- | — |
| i-polar .... | 2 45 kw., 2 120 kw., 4 220 kw., 6 500 kw. | Direct .. | Condensing.... | H.T. feeders, concentric cables. L.T. feeders, lead cvrd. and arm'rd cables | 124,649 8 c.p. | 257 arcs and 1,027 stndrds with 2 incan. lmps. in each | 21,756 .. | 7d. first hour, 1d. after | Wright.. | Ferranti, Thomson-Houston, and Hookham | 4,210 kw. | Welsh coal | — | — | 7/6 | — |
| ..... | 2 84 kw., 1 180 kw. | Direct .. | Non-condensing | Callndr.'s tpl. con. fdrs., 3 core dis., solid, H.T. mains | 7,337, & 80 kw. motors Chislehurst | — | 5,029.... | 7d. and 4d. .. | Maximum demand | Ferranti, Aron, Chamberlain-Hookham | 348 kw. | Durham unscreened | £43,318 | £18,955 | 7/8 | All..... |
| Goolden, Batley | 2 9 kw., 1 10 kw., 1 40 kw. | Belt and countershafting | Non-condensing | Overhead..... | — | — | — | 7½d. lighting, 6d. power | Meters .. | Hookham, Ferranti, and Schattner | 68 kw. | Coal ..... | — | — | — | None .... |
| d E.C.C. .. | 2 90 kw., 1 120 kw., 2 140 k.w. | Rope and direct | Condensing.... | Callender's, laid in ground and solid | 20,400 8 c.p. | 3 Jandus, 12 incandsnt. 8 c.p. | 4,561.... | £8 per kw. of max. demand & 2d. per unit | 6d. & 2d.; 1½d. if exc. 48 h. pr. wk. | Ferranti, Thomson, and Chamberlain-Hookham | 580 kw. | Slack .... | £47,090 | £11,083 | 5/- | All ..... |
| nd ..... | 2 130 kw., 1 250 kw. | Direct .. | Condensing.... | Vul. rub. & Cal. cbs. in c.i. & stone p. or Doulton cond. | 13,927 8 c.p. | 32 arcs .... | 4,636 8 c.p. | 6d. 1st hr., 3d. aft., pr. 3d. 1st hr., 1d. aft. | Brighton | Hookham and Bastian | 510 kw. | Slack .... | £39,000 | £17,000 | 6/2 | All..... |
| utta Percha | 4 38 kw., 2 75 kw... | Direct .. | Koerting's ejector condensers | Triple concentric laid direct in ground | Equivalt. of 8,000 8 c.p. | 12 arcs, 250 incandsnt. | — | 6d. | Level .. | Ferranti, Chmbln.-Hookh'm, Long-Schttnr. (prepay.) | 300 kw. | Coal ..... | — | — | Not yet run full year | — |
| ..... | 4 30 kw., 2 125 kw. | Direct .. | Ledward ejector condensers | Cllndr.'s trpl. con., lead shthd. laid direct in ground | 3,590 incan., 65 arcs | 25 arcs .... | 10,426 .. | — | Meter .. | Ferranti and Cham.-Hookham | 370 kw. | Coal dust .. | £30,000 (about) | — | 1st year incomplete | 3,570 .... |
| ..... | 3 80 kw., 2 250 kw. | Direct .. | Condensing.... | Callender's bitumen cables | 25,786 8 c.p. | 159 arcs, 308 8 c.p. incandescent | 6,510 (exclusive of street ltg.) | 4½d. ltg., 2½d. to 1½d. power to sldg. scale | — | Ferranti, Chamberlain and Hookham | 740 kw. | Gas coke .. | £28,400 | £33,500 | 6/7 | All ..... |
| ..... | 2 40 kw. motor trans. | — | — | Callndr.'s tpl. con. fdrs., 3 core dis., solid, H.T. mains | 4,017..... | — | — | 8d..... | — | Aron, Chambrln.-Hookham | 80 kw. | — | — | — | 7/5 | All..... |
| ..... | 60 kw. ..... | Direct coupled | Surface condnsr. and dplx. pump | Jute & ld. cov. fdrs. Dltn. cond., j.l.c. & arm. dis. in grnd. | Equivalt. of 4,497 8 c.p. | — | 2,385.... | 8d. 1st hr., 5d. after, 4d. pr. | Maximum demand | Chamberlain-Hookham | 180 kw. | Round Nottingham steam coal | £15,614 to Dec. '99 | — | — | None .... |
| n traction.. | 3 235 kw., 2 330 kw. | Direct .. | Condensing.... | Callender's arm'd. solid | 20,437 to 31st Dec. | 60 arcs .... | 18,723, including motors | 5d. and 1d. | Wright's max. demand | Thomson-Houston | — | Coal ..... | — | — | — | All..... |
| ..... | 150 kw..... | Direct .. | Non-con., cond. plant to be added later | Armoured, laid in ground | 8 6 amp. arcs, 3 3 amp. arcs. 4,000 8 c.p. | 17 arcs, 30 25 c.p. incandescent | Only started Sept., 1st, 1899 | Ltg. 4½d., pwr. & heat 3d., pub. ltg. 4d. pr. b.t.u. | — | Bastian, Ferranti, & Chamberlain-Hookham | 300 kw. | Refuse .... | £21,000 | £6,000 | — | All..... |
| ebles..... | 2 100 kw., 1 50 kw., 1 30 kw., 1 125 kw. | Direct .. | Non-condensing | Armoured, lead covrd. in ground | 9,115 8 c.p. | 16 arcs, 32 incandsnt. | 1,960.... | 6d., 3½d. ltg., 3d. & 1½d. for power | Brighton | Ferranti and Hookham | 410 kw. | Fire nuts .. | £25,323 | | 8/- | 2,500..... |
| er ..... | 40 kw., 80 kw., 120 kw.; 300 kw., 500 kw. erecting | Direct .. | Condensing.... | Copr. strip & rub., also Cal'nder's lead cov. in Doultn. con | 38,179 (30 watt) lamps | 50 arcs. .. | 10,213 .. | 4d. per unit, all over 10,000 3d., less 5 % | — | Ferranti ..... | 931 kw. | Wallsend dross, Fife dross | £45,409 | £16,688 | 6/2 | All connecti since 1896 20 |
| polar dyna- | 60 to 780 kw. ..... | Direct .. | — | Armoured cable and bare copper strip | 262,983 8 c.p. | 744 arcs .. | 61,605 .. | 3½d. for ligtg. and 1½d. for power | Reb. 25 % light only. Pwr. nett | — | 8,137 kw. | W. of Scotl'd washed doubles | — | — | 4/6 | 230 v. lamps most enti used |
| rrent..... | 2 160 and 460 v., 2 370 and 460 v.; 2 320 kw., 2,500 v. adding | Direct .. | Non-condensing | Callender's feeders, concen. distributors, 3 core | About 10,000 8 c.p. | 69 arcs and 2 incand. each | 8,000.... | 7d., and 1d. for power | Wright's | Aron, Ferranti, and B. T. H. | — | Welsh coal | — | — | — | All ..... |
| & Co., | 45 kw., 30 kw..... | Direct .. | — | Overhead and underground | 4,500 8 c.p. | 6 arcs, 52 incandesnt. | 500 .... | 6½d. | — | — | 130 kw. | — | £9,500 | | — | 150 volt lar throughout |
| oton ..... | Largest 26 kw., smallest 4 kw. | Belts.... | No steam engines used | Bare cop. tbs. in stn. p., arm. bit. cab., ld. cov. diatrn. in bitu. | 7 arcs, 2,700 8 c.p. | 8 arcs, 3 incandsnt. | About 500 | 5d. lighting, 3d. power | Contract and meter | Chamberln.-Hookham, Thomson-Houston, & Aron | 83·5 | Coke, anth. coal for gas plant | £8,000 | £2,100 | 8/- | None ..... |
| irhead, Sie- Schuckert, r and Coul- Thomson- | 2 48 kw., 2 92 kw., 3 154 kw., 6 225 kw., 1 600 kw., 1 550 kw., 2 230 kw., 2 125 kw., 1 750 kw. | Direct .. | Waterloo Street works non-condensing; Port Dundas condensing | Bare strip rubber cables i. p., arm'd lead covered jute & paper insulator, separate and concentric | 276,575 8 c.p., Nov. 30, 1899 | 237 arcs .. | 55,973, increase for 6 months | 6d. first hour, after, 2½d. 100 v., 2d. 200 v., 1½d. 250 v., over 8 hours no 6d. units | Maximum demand & fixed rate | Ferranti, Chamberlain-Hookham and Bastian | 5,444 kw. | Coke and coal | £420,000 | £210,000 | 6/3 | 100 v., 200 250 v. |
| ..... | 22 kw. ..... | Belt .... | — | Overhead..... | 570 8 c.p... | 28 16 c.p. incandsnt. | 48 ..... | 1/1 per candle per annum | Quarterly | — | 22 kw. | Bituminous coal | £1,000 | £200 | 8/8 | — |
| Houston 6 volts | 95 kw. ..... | Direct coupled | Non-condensing | Callender's ld cov arm'd cables laid direct in ground | Equivalt. of 3,000 8 c.p. applied for | 85 10 amp. arcs | — | 6d. 1st hr., 2d. unit after | Maximum demand | Ferranti and Wright's rebate meters | 190 kw. | Scotch coal | £26,000 | | — | — |
| e, 2 shunt compound, oosters | 2 50 kw. (300 v.). 2 150 kw. (600 v.) | Direct, coupled | Non-condensing | Callender's solid & Callndr.-Webber casing, single cbls. | — | 44 10 amp. arcs | 2,260.... | £7 per kw. and 2d. per unit | 5½d. & 2d. by meter | Aron..... | 300 kw. | Coal, single and double nuts | £35,000 | £13,000 | — | All..... |
| | 3 20 kw., 1 60 kw. .. | Direct .. | — | Armoured cables | 3,000 8 c.p. | — | — | 6d. | Discounts | — | 120 kw. | Welsh coal | £5,500 | £3,000 | — | All..... |
| ..... | 3 60 kw., 1 23 kw. .. | Direct .. | Non-condensing | Bare strip Crompt. sys., Call. cabs. in i. case or pi. & ld. sol | 10,900 8 c.p. and 12 arcs | — | 3,100.... | 7d. lighting, 4d. power | — | Ferranti, Thomson, Schattner, and Bastian | 203 kw. | Welsh coal | £16,600 | £17,300 | 7/- | All..... |
| tta Percha | 200 amps., 500 volts each | Direct .. | Condensing.... | Silvertown rub. cv. in wdn. troughing with bitumen | 9 arcs, 2,283 8 c.p. | — | Opened Dec., '99 | 6d. 1st 2 hrs., 4d. after, 3d. power | Wright's | Ferranti and Wright's max. demand indicator | 200 kw. | Tredegar washed pea nuts | £11,572 | £2,806 | — | All..... |
| ..... | 2 72 kw., 1 150 kw. | Direct coupled | Non-condensing | Callender's triple con. feeders, cbls. lead cov. & arm'd. | 17 arcs 7,236 8 c.p. | 5 arcs, 220 16 c.p. incandscnt. | 6,000.... | Ltg. 7d., 4d. & 2d., motors 4d. and 1½d. | Wright's max. demand | Ferranti, Chamberlain-Hookham, and Aron | 194 kw. | Hard steam coal | £32,415 | 10,000 | 5/3 | 7,686..... |
| ..... | 3 60 kw., 1 154 kw., 1 90 kw., 2 222 kw., 1 23 kw. | Direct .. | Non-condensing | In culvrts., and i.r. cable in c.i. pipes | 44,892, 33 watt | 20 8 c.p. incandescnt. | 7,925.... | 8d. first hour, 4d. after, discounts | Brighton | Ferranti ..... | 1,045 kw. | Welsh coal | £42,690§ | £42,641 | 5/5 | 25,327 ..... |
| ..... | 35 to 45 amps., 330 to 250 v. | Belts.... | — | Callender's, lead sheathed and steel armoured | 400 incand. | 32 32 c.p... | 500 .... | 6d. per unit | Meters & contract | Schattner ..... | 23 kw. | Water power | £3,500 (about) | | — | 70 200 v. .... |
| ..... | 2 75 kw. ..... | Direct .. | — | Callender's armoured | 11,344 8 c.p. | — | 2,098.... | 6d. lighting, 3d. power | No rebate | Kelvin and Ferranti | 150 kw | Screened nuts | £26,160 | £9,660 | — | None ..... |
| ..... | 40 kw. ..... | Belts.... | — | Con. fdrs. lead. sh., partly cond., partly arm'd laid direct | 12 arcs, 5,750 8 c.p. incandsnt. | 14 arcs, 1,250 8 c.p. incandsnt. | All..... | 5½d. | Uniform charge | Ferranti and Thomson | 200 kw. | Anthracite pea nuts | £29,500 | — | — | All..... |
| and Platt | 1 120 kw., 1 80 kw., 1 36 kw., 1 180 kw. | Direct .. | Condensing.... | Callender's bitumen cable | In Mar. 1899, 17,807 8 c.p. | To date, 29 arcs, 55 incandsnt. | From Mar. 25 to Dec 31, 3,210 | 4½d. lighting, 3d. power | 5 % disct. | Principally Hookham | 420 kw. | Burgie .... | £28,662 | | 5/1½ | None ..... |
| Hookham | 4 80 kw., 1 30 kw... | Ropes and belts | Condensing.... | Callender's, brick culverts and also armoured feeders | 8,448 8 c.p. | — | 1,700.... | 7d. to 5d. | Rd. aft. 12 units pr. 16 c.p. pr. qtr. | Hookham ..... | 304 kw. | Coal ..... | — | — | 6/2 | — |
| hoe 2 pole | 4 92 kw., 1 60 kw... | Direct .. | Non-condensing | B.I.W., laid direct in grnd. with steel protection plates | 14,000 8 c.p. | 105 arcs | 14,000, b'n running a year | 5d. unit ltg., 1½d. power | Meter .. | Ferranti and Aron | 428 kw. | Washed pearls | £30,000 (in mains) | £7,900 | — | — |
| E.C.C., Co., and | 4 35 kw., 4 52 kw., 1 290 kw. | Belts and dir. cpld. steam | Non-condensing | Siemens' conc. in Doulton con. arm. West Elec., Call. | 85 arcs, 18,000 8 c.p. | 12 arcs, 267 incandescent | 9,131.... | 5d. 1st 1½ hr., 2d. aft. ltg. 5d. 1st hr, 1d. aft. pr. | Brighton | Ferranti, Thomson, and Hookham | 578 kw. | Welsh anthracite & hard steam | £59,478 | £20,000, service £4,200 | 5/6 | None ..... |
| Co ..... | 3 of 66 kw., 2 of 200 kw. | Direct coupled | Ejector condensers | Armrd. conc. and triple conc. laid in bitumen | About 11,000 8 c.p. | 30 arcs, 60 incand. | — | 6d. 1st hr's av. dmard. p. day p. qtr., 2½d. aft. | — | Ferranti and Schattner | 598 kw. | Coal ..... | £32,000 | £9,000 approx. | — | — |
| C. ..... | 160 kw. and 600 k.w. | Direct .. | Condensing and non-condensing | Callender's solid .. | 117,773 16 c.p. | 142 arcs .. | 26,652 16 c.p. | 4d. lighting, 2d. and 1d. power | — | Hookham and Ferranti | 7,090 kw. | Slack .... | — | — | — | — |
| ..... | 2 100 kw., 1 50 kw. | Direct .. | Ledward evaporative condrs. | Triple con. feeders, 3 core distribtrs. | 12,000 8 c.p. | 48 arcs, with incan. bkts. on 4 poles | Started Nov. 5, 1898 | 6d. per unit (Scale A) | 7d. 1st hr., 3½d. aft. (Scale B) | Bastian and Ferranti | — | Coke..... | £25,000 | — | — | — |
| no ..... | 39 kw. ..... | Leather belting | Non-condensing | Bare wire overhead | 1,000 8 c.p., 6 arcs | None yet .. | 200..... | 4½d. per unit | Meter and per lamp | Chambrln.-Hookham and Bastian Electrolytic | 49 kw. | Small coal, ref. collected from streets | £2,000 | | Cannot yet be stated | All ..... |
| l-polar .. | 12 250 kw., 2 1,500 kw. | Belts and direct | Condensing.... | Bare cop. con. cul., vul. rub. in p. vul. rub., vul bit., & ld. cov. paper, laid sol. | 2,095 arcs, 222,176 8 c.p. incandescent | 29 arcs .... | 46,636 .. | 5d. or £7 kw., inst. plus 1½d. unit, spcl. pwr. rts. 1½d. or 2½d. | Hopkinson | Ferranti, Thomson-Houston, Aron, Chamberlain-Hookham | 6,000 kw. | Washed slack | £263,620, excluding mains to Mr. 31, '99 | £230,096 | 3/5 | A considerabl number |
| ..... | 26 kw. ..... | Belt .... | Non-condensing | Overhead wire .. | — | 36 incndsnt. | 80 ..... | 6d. per unit | — | Thomson and Hookham | — | Welsh steam coal | — | — | — | — |

# view" List of Electricity Works o

# LOW PRESSURE CONTINUOUS C

| rbines and H.P. of ch unit. | Type of Generators. | Size of Generators. | System of Driving. | Condensing or Non-condensing. | System of Mains. | Number of Arc and Incandescents used in Private Lighting. | Number of Lamps used in Street Lighting, Arc and Incandescent. | Number of 8 C.P. Lamps added during past 12 months. | Price Charged to Private Consumers. | System of Charging. | Type of Meters Employed on Consumers' Premises. | Present actual Capacity of Works in kw. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| h.p., 3 do. 80 h.p., ., 2 do. 300 h.p., 1 .h.p. | E.C.C., Holmes, Crompton, Bruce Peebles, Mather and Platt | 2 23 kw., 3 48 kw., 2 120 kw., 2 180 kw. 1 390 kw. | Direct .. | Non-condensing | Bare copper, Callender, B.I.W., and Siemens | 48,544 8 c.p. | 126 10 amp. arcs, 200 incandsnt. | 15,190 .. | 6d. and 3d. ltg., 3d. and 1d. power | Brighton | Ferranti, British Thomson-Houston | 1,180 kw. | Co |
| .p., 550 revs. .... | Ediswan 2 pole under type.. | 46 kw. ..... | Direct .. | Non-condensing, Berryman feed water htr. used | Cllndr.'s fdrs. trpl. con. arm., ld. sh., Dis. 3 c.arm. ld.sh | — | — | 1,200.... | 7d. and 4d. | Brighton | Chamberlain-Hookham | 92 kw. | |
| dley) inverted en- 500 h.p. each | 3 bi-polars, P. R. Jackson's, with Sayers winding | 300 kw. each ..... | Direct .. | Condensing arrangements erecting | Concntrc. B.I.W., lead covd., drawn into Doult'n pipes | 71 arcs, 8,150 8 c.p. incandsnt. | 72 arcs, 160 incand. | — | 7d. first hour, 2d. after | Wright's | Chamb'lain-Hookh'm. and Wright's demand indicator | 900 kw. | Bo |
| gines, 4 120 do.; 2 .p., 2 do. 350 h.p., | 2 pole under-type; 6 2 pole, 4 multi-polar | 2 26 kw., 4 57 kw., 2 200 kw., 4 50 kw., 4 500 kw. | Rope and direct | Condensing.... | Bitumen cable in stoneware casing, c.i. pipes & solid | 52,000 8 c.p. | — | 14,000 .. | Lgt, 7d. 1st hr., 2d. aft.; pr., 4d. 1st hr., 1½d. aft. | Wright's | Chamberlain-Hookham and Ferranti | 2,850 kw. | Ga W E |
| h.p. ..... | Brush, Paterson and Cooper and E.C.C. | 1 12 kw., 1 15 kw., 1 18 kw. | Rope.... | Non-condensing | Armoured ..... | — | 16 arcs .... | 120 .... | — | — | — | 45 kw. | Co |
| i.h.p., 2 (Willans) | Crompton and Siemens .... | 3 50 kw., 2 150 kw. | Direct .. | Non-condensing | Callender's ..... | 98 arcs, 14,302 8 c.p. | 12 arcs, 10 incandsnt. | 5,537.... | 6d. ltg., 4d. pr., rebate to 3d. aft. 1½ hours | Discounts | Ferranti ..... | 450 kw. | Sla |
| lliss ..... | Crompton and E.C.C. ..... | — | Direct .. | Non-condensing | Bare copper and Callender's, in c.i. conduits | 125,400 8 c.p. lamps | None..... | — | 7d. | Sliding scale | Hookham and Ferranti | — | |
| h.p., 2 do. 100 h.p., 1 do. 360 h.p., 2 .p., 1 do. 360 h.p., | Siemens, Mather and Platt and E.C.C. | 2 45 kw., 2 120 kw., 2 150 kw., 1 225 kw., 1 500 kw. con.; 2 60 kw., 1 200 kw. alternating | Direct .. | Part condensing | L.T. rub. in c.i. conduits, alterng. feed. con. arm'rd | 22,793 .... | 76 arcs, 239 incand. | — | 6d. and 3d. ltg., 2½d. and 1½d. power | Brighton | Hookham, Ferranti, and Thomson | 1,675 kw. | Sla |
| 1,000 h.p., 2 do. | Mather and Platt 12 pole .. | 2 600 kw., 2 300 kw. | Direct .. | Both..... | Triple concentric paper, B.I.W. | — | — | — | — | — | Ferranti ..... | 1,800 kw. | Sla |
| h.p., 3 do. 250 h.p. | Parker..... | 2 75 kw., 3 150 kw. | Direct .. | Condensing.... | B.I.W..... | 8,588 8 c p. | 36 arcs, 72 incandsnt. | — | 5d. and 3d. lt., 5d. & 1½d. pr. | Wright's | Chamberlain-Hookham | — | Bur |
| ..... | Siemens ..... | 80 to 380 kw. ..... | Direct .. | Condensing.... | Feeders armoured dist. arm'rd, laid in ground | 746 arcs, 74,300 8 c.p. | 51 arcs, 35 incandsnt. | 14,300 in., 1,885 arcs, 21,489 mts. | 4½d. ltg., 2d. intermtnt. pr., 1d. cont. pwr. | 2½ discnt. and free lamps. | Thomson, Hkham., Ferranti, Bastian, Brillié, and Aron | 2,769 kw. | Coa |
| 7 h.p., 1 14 h.p., inal | Kapp ..... | 1 7 kw., 1 13 kw., 1 16 kw. | Belt .... | — | Overhead..... | 20 arcs, 1,000 8 c.p. | — | 160 .... | 6d. | Meter .. | Chamb'lain-Hookham, Ferranti, and Bastian | 36 kw. | Gas |
| llans), 2 200 h.p. 60 h.p. (Willans), llans) | 6 multi-polar, 8 bi-polar .... | 2 45 kw., 2 120 kw., 4 220 kw., 6 500 kw. | Direct .. | Condensing.... | H.T. feeders, concentric cables. L.T. feeders, lead cvrd. and arm'rd cables | 124,649 8 c p. | 257 arcs and 1,027 stndrds with 2 incan. lmps. in each | 21,756 .. | 7d. first hour, 1d. after | Wright.. | Ferranti, Thomson-Houston, and Hookham | 4,210 kw. | Wel |
| , 1 (Belliss) t.e.c./3 | Parker 2 pole..... | 2 84 kw., 1 180 kw. | Direct .. | Non-condensing | Callndr.'s tpl. con. fdrs., 3 core dis., solid, H.T. mains | 7,337, & 80 kw. motors Chislehurst | — | 5,029.... | 7d. and 4d. .. | Maximum demand | Ferranti, Aron, Chamberlain-Hookham | 348 kw. | Dur sc |
| semi-portable, 40 p. | Elwell - Parker, Goolden, Greenwood and Batley | 2 9 kw., 1 10 kw., 1 40 kw. | Belt and counter-shafting | Non-condensing | Overhead..... | — | — | — | 7½d. lighting, 6d. power | Meters .. | Hookham, Ferranti, and Schattner | 68 kw. | Coa |
| 0 h.p. horizontal, ical (Belliss) | Elwell-Parker and E.C.C. .. | 2 90 kw., 1 120 kw., 2 140 k.w. | Rope and direct | Condensing.... | Callender's, laid in ground and solid | 20,400 8 c.p. | 3 Jandus, 12 incandsnt. 8 c.p. | 4,561.... | £8 per kw. of max. demand & 2d. per unit | 6d. & 2d.; 1½d. if exc. 48 h. pr. wk. | Ferranti, Thomson, and Chamberlain-Hookham | 580 kw. | Slac |
| h.p., 1 (Belliss) | 2 pole shunt wound ..... | 2 130 kw., 1 250 kw. | Direct .. | Condensing.... | Vul. rub. & Cal. cbs. in c.i. & stone p. or Doulton cond. | 13,927 8 c.p. | 32 arcs .... | 4,636 8 c.p. | 6d. 1st hr., 3d. aft., pr. 3d. 1st hr., 1d. aft. | Brighton | Hookham and Bastian | 510 kw. | Slac |
| 250 b.h.p..... | India-rubber & Gutta Percha Co. | 4 38 kw., 2 75 kw... | Direct .. | Koerting's ejector condensers | Triple concentric laid direct in ground | Equivalt. of 8,000 8 c.p. | 12 arcs, 250 incandsnt. | — | 6d. | Level .. | Ferranti, Chmbln.-Hookh'm, Long-Schttnr. (prepay.) | 300 kw. | Coa |
| i.h.p., 2 do. 200 | Siemens bi-polar ..... | 4 30 kw., 2 125 kw. | Direct .. | Ledward ejector condensers | Cllndr.'s trpl. con., lead shthd. laid direct in ground | 3,590 incan., 65 arcs | 25 arcs .... | 10,426 .. | — | Meter .. | Ferranti and Cham.-Hookham | 370 kw. | Coa |
| h.p., 2 (Belliss) | Parker ..... | 3 80 kw., 2 250 kw. | Direct .. | Condensing.... | Callender's bitumen cables | 25,786 8 c.p. | 159 arcs, 308 8 c.p. incandescent | 6,510 (exclusive of street ltg.) | 4½d. ltg., 2½d. to 1½d. power to sldg. scale | — | Ferranti, Chamberlain and Hookham | 740 kw. | Gas |
| ntinuous current y) | Parker ..... | 2 40 kw. motor trans. | — | — | Callndr.'s tpl. con. fdrs., 3 core dis., solid, H.T. mains | 4,017..... | — | — | 8d..... | — | Aron, Chambrln.-Hookham | 80 kw. | |
| .h.p..... | Siemens 2 pole ..... | 60 kw. ..... | Direct coupled | Surface condnsr. and dplx. pump | Jute & ld. cov. fdrs. Dltn. cond., j.l.c. & arm. dis. in grnd. | Equivalt. of 4,497 8 c.p. | — | 2,385.... | 8d. 1st hr., 5d. after, 4d. pr. | Maximum demand | Chamberlain-Hookham | 180 kw. | Rou tin ste |
| eymour) 300 h.p., p. | Thomson-Houston traction.. | 3 235 kw., 2 330 kw. | Direct .. | Condensing.... | Callender's arm'd. solid | 20,437 to 31st Dec. | 60 arcs .... | 18,723, including motors | 5d. and 1d. | Wright's max. demand | Thomson-Houston | — | Coal |
| .p. ..... | Siemens 2 pole ..... | 150 kw..... | Direct .. | Non-con., cond. plant to be added later | Armoured, laid in ground | 8 6 amp. arcs, 3 3 amp. arcs. 4,000 8 c.p. | 17 arcs, 30 25 c.p. incandescent | Only started Sept. 1st, 1899 | Ltg. 4½d., pwr. & heat 3d., pub. ltg. 4d. pr. b.t.u. | — | Bastian, Ferranti, & Chamberlain-Hookham | 300 kw. | Refu |
| 0, 1 (Willans) 80, 1 (Willans) 250 | Crompton and Peebles..... | 2 100 kw., 1 50 kw., 1 30 kw., 1 125 kw. | Direct .. | Non-condensing | Armoured, lead covrd. in ground | 9,115 8 c.p. | 16 arcs, 32 incandsnt. | 1,960.... | 6d., 3½d. ltg., 3d. & 1½d. for power | Brighton | Ferranti and Hookham | 410 kw. | Fire |
| ,226 h.p.; 2 450 . erecting | Siemens and Parker ..... | 40 kw., 80 kw., 120 kw.; 300 kw., 500 kw. erecting | Direct .. | Condensing.... | Copr. strip & rub., also Cal'nder's lead cov. in Doultn. con | 38,179 (30 watt) lamps | 50 arcs. .. | 10,213 .. | 4d. per unit, all over 10,000 3d., less 5 % | — | Ferranti ..... | 931 kw. | Wall dro dro |
| ,200 h.p..... | 2 pole and multi-polar dynamos | 60 to 780 kw. ..... | Direct .. | — | Armoured cable and bare copper strip | 262,983 8 c.p. | 744 arcs .. | 61,605 .. | 3½d. for ligtg. and 1½d. for power | Reb. 25 % light only. Pwr. nett | — | 8,137 kw. | W. o l'd dou |
| h.p., 2 (Peache) | Parker's direct current..... | 2 160 and 460 v., 2 370 and 460 v.; 2 320 kw., 2,500 v. adding | Direct .. | Non-condensing | Callender's feeders, concen. distributors, 3 core | About 10,000 8 c.p. | 69 arcs and 2 incand. each | 8,000.... | 7d., and 1d. for power | Wright's | Aron, Ferranti, and B. T. H. | — | Wels |
| nes, 60 h.p. each, ine, 40 h.p. | Laurence, Scott & Co., General Electric | 45 kw., 30 kw..... | Direct .. | — | Overhead and underground | 4,500 8 c.p. | 6 arcs, 52 incandesnt. | 500 .... | 6½d. | — | — | 130 kw. | |
| les) turbines and 1 engine with Dow- | Statter and Crompton ..... | Largest 26 kw., smallest 4 kw. | Belts.... | No steam engines used | Bare cop. tbs. in stn. p., arm. bit. cab., ld. cov. diatrn. in bitu. | 7 arcs, 2,700 8 c.p. | 8 arcs, 3 incandsnt. | About 500 | 5d. lighting, 3d. power | Contract and meter | Chamberln.-Hookham, Thomson-Houston, & Aron | 83·5 | Coke coal gas |
| .p., 2 do. 150 h.p., 3 o. 350 h.p., 1 (Ball- 1 (M. Paul) 900 h.p., tson) 400 h p., 1 do. (McLellan) 200 h.p., .p., 2 do. 1,100 h p. | Latimer Clark, Muirhead, Siemens, Walker, Schuckert, Crompton, Mavor and Coulson, British Thomson-Houston | 2 48 kw., 2 92 kw., 3 154 kw., 6 225 kw., 1 600 kw., 1 550 kw., 2 230 kw., 2 125 kw., 1 750 kw. | Direct .. | Waterloo Street works non-condensing; Port Dundas condensing | Bare strip rubber cables i. p., arm'd lead covered jute & paper insulator, separate and concentric | 276,575 8 c p., Nov. 30, 1899 | 237 arcs .. | 55,973, increase for 6 months | 6d. first hour, after, 2½d. 100 v., 2d. 200 v., 1½d. 250 v., over 8 hours no 6d. units | Maximum demand & fixed rate | Ferranti, Chamberlain-Hookham and Bastian | 5,444 kw. | Coke |
| engine ..... | Elwell and Parker..... | 22 kw. ..... | Belt .... | — | Overhead..... | 570 8 c.p... | 28 16 c.p. incandsnt. | 48 ..... | 1/1 per candle per annum | Quarterly | — | 22 kw. | Bitun coal |
| .p. ..... | British Thomson-Houston 6 pole, 500 to 600 volts | 95 kw. ..... | Direct coupled | Non-condensing | Callender's ld cov arm'd cables laid direct in ground | Equivalt. of 3,000 8 c.p. applied for | 85 10 amp. arcs | — | 6d. 1st hr., 2d. unit after | Maximum demand | Ferranti and Wright's rebate meters | 190 kw. | Scotc |
| i.h.p., 2 do. 250 | Silvertown 2 pole, 2 shunt wound, 300 v., 2 compound, 600 v., 2 motor boosters | 2 50 kw. (300 v.). 2 150 kw. (600 v.) | Direct, coupled | Non-condensing | Callender's solid & Callndr.-Webber casing, single cbls. | — | 44 10 amp. arcs | 2,260.... | £7 per kw. and 2d. per unit | 5½d. & 2d. by meter | Aron..... | 300 kw. | Coal, and nuts |
| ) i.h.p. ..... | —— | 3 20 kw., 1 60 kw. .. | Direct .. | — | Armoured cables | 3,000 8 c.p. | — | — | 6d. | Discounts | — | 120 kw. | Welsh |
| ..... | Crompton ..... | 3 60 kw., 1 23 kw. .. | Direct .. | Non-condensing | Bare strip Crompt. sys., Call. cabs. in i. case or pi. & ld. sol | 10,900 8 c.p. and 12 arcs | — | 3,100.... | 7d. lighting, 4d. power | — | Ferranti, Thomson, Schattner, and Bastian | 203 kw. | Welsh |
| h.p. each ..... | India-rubber & Gutta Percha Co. | 200 amps., 500 volts each | Direct .. | Condensing.... | Silvertown rub. cv. in wdn. troughing with bitumen | 9 arcs, 2,283 8 c.p. | — | Opened Dec., '99 | 6d. 1st 2 hrs., 4d. after, 3d. power | Wright's | Ferranti and Wright's max. demand indicator | 200 kw. | Trede wash nuts |
| 0 h.p. each, 1 .p. | Parker ..... | 2 72 kw., 1 150 kw. | Direct coupled | Non-condensing | Callender's triple con. feeders, cbls. lead cov. & arind. | 17 arcs 7,236 8 c.p. | 5 arcs, 220 16 c.p. incandscnt. | 6,000.... | Ltg. 7d., 4d. & 2d., motors 4d. and 1½d. | Wright's max. demand | Ferranti, Chamberlain-Hookham, and Aron | 194 kw. | Hard coal |
| .p., 2 do. 250 h.p., p., 1 do. 38 h.p., h.p. | Crompton ..... | 3 60 kw., 1 154 kw., 1 90 kw., 2 222 kw., 1 23 kw. | Direct .. | Non-condensing | In culvrts., and i.r. cable in c.i. pipes | 44,892, 33 watt | 20 8 c.p. incandescnt. | 7,925.... | 8d. first hour, 4d. after, discounts | Brighton | Ferranti ..... | 1,045 kw. | Welsh |
| x turbines, 16 to | Hall ..... | 35 to 45 amps., 330 to 250 v. | Belts.... | — | Callender's, lead sheathed and steel armoured | 400 incand. | 32 32 c.p.... | 500 .... | 6d. per unit | Meters & contract | Schattner ..... | 23 kw. | Wate |
| h.p. ..... | Goolden ..... | 2 75 kw. ..... | Direct .. | — | Callender's armoured | 11,344 8 c.p. | — | 2,098.... | 6d. lighting, 3d. power | No rebate | Kelvin and Ferranti | 150 kw | Scree |
| b.h.p. each .... | 2 pole, 400 volts ..... | 40 kw. ..... | Belts.... | — | Con. fdrs. lead. sh, partly cond, partly arm'd laid direct | 12 arcs, 5,750 8 c.p. incandsnt. | 14 arcs, 1,250 8 c.p. incandsnt. | All..... | 5½d. | Uniform charge | Ferranti and Thomson | 200 kw. | Anthr pe |
| h.p., 1 (Willans) Willans) 135 h.p., h.p | 3 Brush, 1 Mather and Platt | 1 120 kw., 1 80 kw., 1 36 kw., 1 180 kw. | Direct .. | Condensing.... | Callender's bitumen cable | In Mar. 1899, 17,807 8 c.p. | To date, 29 arcs, 55 incandsnt. | From Mar. 25 to Dec 31, 3,210 | 4½d. lighting, 3d. power | 5 % disct. | Principally Hookham | 420 kw. | Burgi |
| ., 1 horiz. 30 h.p. | Chamberlain and Hookham | 4 80 kw., 1 30 kw... | Ropes and belts | Condensing.... | Callender's, brick culverts and also armoured feeders | 8,448 8 c.p. | — | 1,700.... | 7d. to 5d. | Rd. aft. 12 units pr. 16 c.p. pr. qtr. | Hookham ..... | 304 kw. | Coal . |
| h.p., 1 do. 100 h.p. | Silvertown horse-shoe 2 pole inverted machines | 4 92 kw., 1 60 kw... | Direct .. | Non-condensing | B I.W., laid direct in grnd. with steel protection plates | 14,000 8 c.p. | 105 arcs | 14,000, b'n running a year | 5d. unit ltg., 1½d. power | Meter .. | Ferranti and Aron | 428 kw. | Wash |
| ngines, 60 b.h.p., 4 , 1 (Willans) 350 | Fuller-Wenström, E.C.C., General Electric Co., and Mather & Platt | 4 35 kw., 4 52 kw., 1 290 kw. | Belts and dir. cpld. steam | Non-condensing | Siemens' conc. in Doulton con. arm. West Elec., Call. | 85 arcs, 18,000 8 c.p. | 12 arcs, 267 incandescent | 9,131.... | 5d. 1st 1½ hr., 2d. aft. ltg. 5d. 1st hr, 1d. aft. pr. | Brighton | Ferranti, Thomson, and Hookham | 578 kw. | Welsh thrac hard |
| i.h p., 2 (Willans) | Laurence, Scott & Co ..... | 3 of 66 kw., 2 of 200 kw. | Direct coupled | Ejector condensers | Armrd. conc. and triple conc. laid in bitumen | About 11,000 8 c.p. | 30 arcs, 60 incand. | — | 6d. 1st hr's av. dmar d. p. day p. qtr., 2½d. aft. | — | Ferranti and Schattner | 598 kw. | Coal . |
| p. and 1,200 h.p. | Siemens and E.C.C. ..... | 160 kw. and 600 k.w. | Direct .. | Condensing and non-condensing | Callender's solid .. | 117,773 16 c.p. | 142 arcs .. | 26,652 16 c.p. | 4d. lighting, 2d. and 1d. power | — | Hookham and Ferranti | 7,090 kw. | Slack |
| 5 h.p..... | Shunt wound ..... | 2 100 kw., 1 50 kw. | Direct .. | Ledward evaporative condrs. | Triple con. feeders, 3 core distribtrs. | 12,000 8 c.p. | 48 arcs, with incan. bkts. on 4 poles | Started Nov. 5, 1898 | 6d. per unit (Scale A) | 7d. 1st hr., 3½d. aft. (Scale B) | Bastian and Ferranti | — | Coke. |
| m comp., 56 b.h.p. | Shunt-wound dynamo ..... | 39 kw. ..... | Leather belting | Non-condensing | Bare wire overhead | 1,000 8 c.p., 6 arcs | None yet .. | 200 ..... | 4½d. per unit | Meter and per lamp | Chambrln.-Hookham and Bastian Electrolytic | 49 kw. | Small ref. co from s |
| 2,500 h.p. ..... | 12 bi-polar, 2 multi-polar .. | 12 250 kw., 2 1,500 kw. | Belts and direct | Condensing.... | Bare cop. con. cul., vul. rub. in p. vul. rub., vul bit., & ld. cov. paper, laid sol. | 2,095 arcs, 222,176 8 c.p. incandescent | 29 arcs .... | 46,636 .. | 5d. or £7 kw., inst. plus 1½d. unit, spcl. pwr. rts. 1½d. or 2½d. | Hopkinson | Ferranti, Thomson-Houston, Aron, Chamberlain-Hookham | 6,000 kw. | Washe |
| 30 h.p. ..... | Crompton ..... | 26 kw. ..... | Belt .... | Non-condensing | Overhead wire .. | — | 36 incndsnt. | 80 ..... | 6d. per unit | — | Thomson and Hookham | — | Welsh coal |

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# S CURRENT.

| f Meters yed on Premises. | Present actual Capacity of Works in kw. | Nature of Fuel used. | Total Cost of Constructing and Equipping Works. | Cost of Mains. | Annual Revenue per 8 C.P Lamp. | Number of High Voltage Lamps used. | Declared Pressure at Consumers' Terminals. | No. and aggregate H.P. of Motors connected. | Remarks. | Engineer-in-Chief. | PLACE. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | **PROVINCIAL.** |
| British -Houston | 1,180 kw. | Coal ..... | £65,000 | | — | Used exclusively | 220 v. .... | 155 = 25 h.p. .. | — | J. Alex. Bell.... | **Aberdeen** .....(1) |
| lain- Hookham | 92 kw. | — | — | — | — | — | 210 v. .... | — | Supply started October, 1899 | Herbert W. Watts | **Alderley and Wilmslow** (2) |
| in-Hook- Wright's indicator | 900 kw. | Bolsover slack | — | — | — | — | 200 v. .... | 500 h.p. ..... | — | W. H. Vincent | **Ashton-under-Lyne** (3) |
| lain- m and | 2,850 kw. | Gas, small Welsh and Eng. slack | — | — | — | All..... | 220 v. .... | 300 h.p. ..... | — | Victor A. H. McCowen | **Belfast** .....(4) |
| | 45 kw. | Coal ..... | £3,000 | £200 | — | None ..... | — | 1 ..... | — | C. L. N. Wilson | **Bilston** .....(5) |
| ..... | 450 kw. | Slack .... | — | — | — | All ..... | 230 v .... | 10 = 28 h.p. .. | — | William Bates | **Birkenhead** ....(6) |
| and Ferranti | — | — | — | — | — | — | — | 186 = 475 h.p. | — | J. C. Vaudrey.. | **Birmingham** ....(7) |
| , and n | 1,675 kw. | Slack .... | £51,553 | £29,882 | 5/10 | Used on outskirts of L.T. area | 110 v. and 220 v.; 500 v. to tramway dept. | 538 h.p. ..... | Changing over pressure this year to 220 v., 440 v. | A. S. Giles .... | **Blackburn*** .....(8) |
| ..... | 1,800 kw. | Slack .... | £45,000 | £5,000 (feeders) | — | — | 230 v. .... | — | — | A. Ellis ..... | **Bolton** .....(9) |
| ain- ookham | — | Burgie .... | — | — | — | — | 220 v. .... | 6 = 20½ h.p. .. | — | W. R. Wright.. | **Bootle** .....(10) |
| Hkham., Bastian, nd Aron | 2,769 kw. | Coal ..... | — | — | — | Used throughout | 230 v. .... | 225 = 820 h.p. | — | — | **Bradford**.....(11) |
| n-Hook- Ferranti, ian | 36 kw. | Gas ..... | £2,000 | | 8/- | — | 110 v. .... | 6 = 13 h.p..... | — | J. W. Garside.. | **Brighouse** .....(12) |
| Thom- ton, and | 4,210 kw. | Welsh coal | — | — | 7/6 | — | 115 v. and 230 v. | Abt. 150 motors | — | Arthur Wright | **Brighton*** .....(13) |
| Aron, rlain- n | 348 kw. | Durham unscreened | £43,318 | £18,955 | 7/8 | All..... | 210 v. .... | — | Started Nov., '98 | R. L. Gamlen.. | **Bromley (Kent)** (14) |
| and r | 68 kw. | Coal ..... | — | — | — | None ..... | 100 v. .... | — | — | Messrs. Gillies and Hornidge | **Buckingham**....(15) |
| homson, nberlain- | 580 kw. | Slack .... | £47,090 | £11,083 | 5/- | All ..... | 220 v. .... | 40 h.p. ..... | — | R. Birkett .... | **Burnley** .....(16) |
| and Bastian | 510 kw. | Slack .... | £39,000 | £17,000 | 6/2 | All..... | 220 v. .... | 33 h.p. ..... | — | S. J. Watson .. | **Bury** .....(17) |
| Chmbln.- , Long- prepay.) | 300 kw. | Coal ..... | — | — | Not yet run full year | — | 220 v, .... | 5 = 120 h.p. abt. | — | Norman Staniland | **Canterbury** ....(18) |
| nd ookham | 370 kw. | Coal dust.. | £30,000 (about) | — | 1st year incomplete | 3,570 ..... | 230 v. .... | 46 = 159¼ h.p. | 2 800 h.p. Willans, multipl. gen. being inst., & 2 boilers. | Chas. G. Burnet | **Carlisle** .....(19) |
| Chamnd ookham | 740 kw. | Gas coke .. | £28,400 | £33,500 | 6/7 | All ..... | 210 v. .... | 38 = 94 h.p. .. | — | F. Thursfield .. | **Chester** .....(20) |
| mbrln.- n | 80 kw. | — | — | — | 7/5 | All..... | 210 v. .... | None..... | Started Feb., '99 | F. S. Hanning.. | **Chislehurst** ....(21) |
| in- ookham | 180 kw. | Round Nottingham steam coal | £15,614 to Dec.'99 | — | — | None ..... | 150 v. .... | 4 = 3 h.p. .... | Current supplied from Dec. 1st, '98 | Alfred R. Sillar | **Colchester**.....(22) |
| Houston | — | Coal ..... | — | — | — | All..... | 230 v. and 460 v. | 373 h.p., not including traction | — | C. H. Merz .. | **Cork**.....(23) |
| erranti, berlain- | 300 kw. | Refuse .... | £21,000 | £6,000 | — | All..... | 230 v. .... | 9 = 8 h.p. .... | Coal fired blr. and Belliss-Mather and Platt set for tractn. | Stanley Clegg.. | **Darwen (Lanes.)** (24) |
| nd ookham | 410 kw. | Fire nuts .. | £25,323 | | 8/- | 2,500..... | 220 v. and 110 v. | 9 = 25 h.p..... | — | O. M. Jonas.... | **Dewsbury** .....(25) |
| ..... | 931 kw. | Wallsend dross, Fife dross | £45,409 | £16,688 | 6/2 | All connections since 1896 200 v. | 200 v. .... | 47 ..... | — | Walter H. Tittensor | **Dundee** .....(26) |
| | 8,137 kw. | W. of Scotl'd washed doubles | — | — | 4/6 | 230 v. lamps almost entirely used | 230 v. continuous | 385 = 1,112 h.p. | — | Frank A. Newington | **Edinburgh*** ....(27) |
| erranti, H. | — | Welsh coal | — | — | — | All ..... | 210 v. .... | 6 = about 17 h.p. | — | Thos. Hesketh | **Folkestone** ....(28) |
| | 130 kw. | — | £9,500 | | — | 150 volt lamps throughout | 150 v. .... | 4 h.p. ..... | — | Irvine Reid.... | **Fort William** ..(29) |
| -Hook- omson- & Aron | 83·5 | Coke, anth. coal for gas plant | £8,000 | £2,100 | 8/- | None ..... | 110 v. .... | 4 = 5½ h.p..... | Con. engineer and manag'ng direct. James Perry | Leopold Heath | **Galway (Ireland)** (30) |
| Chamokham n | 5,444 kw. | Coke and coal | £420,000 | £210,000 | 6/3 | 100 v., 200 v., 250 v. | 250 v. .... | 182 h.p. ..... | Waterloo St. 3,300 h.p., Port Dundas wks. cnstrctg., but has 2,844 kw. in use; Pollokshaws Rd. stn. plt. constg | W. A. Chamen | **Glasgow**.....(31) |
| | 22 kw. | Bituminous coal | £1,000 | £200 | 8/8 | — | 100 v. .... | — | About to replace present engine by 35 h.p. oil engine | F. J. Francis .. | **Gorseinon**.....(32) |
| d ebate | 190 kw. | Scotch coal | £26,000 | | — | — | 250 v. .... | None ..... | Statn. op. Jan., '00 No econs. Fd. htr. Tudor battery | James Brown .. | **Govan**.....(33) |
| ..... | 300 kw. | Coal, single and double nuts | £35,000 | £13,000 | — | All..... | 250 v. .... | — | Econo. & feed htr. used; chain grate motr. drvn. stokr. | S. E. Fedden .. | **Greenock** .....(34) |
| | 120 kw. | Welsh coal | £5,500 | £3,000 | — | All..... | — | — | — | J. M. V. Money-Kent | **Guildford†** ....(35) |
| omson, and | 203 kw. | Welsh coal | £16,600 | £17,300 | 7/- | All..... | 220 v. .... | 3 = 6 h.p. .... | — | Arthur H. Shaw | **Harrow-on-the-Hill** (36) |
| d nax. decator | 200 kw. | Tredegar washed pea nuts | £11,572 | £2,806 | — | All..... | 220 v. .... | None ..... | Chloride battery, 270 cells | F. G. Poulton.. | **Hereford** .....(37) |
| Chamokham, | 194 kw. | Hard steam coal | £32,415 | 10,000 | 5/3 | 7,636..... | 210 v. .... | 66⅔ ..... | Total revenue £2,030 | E. Salthouse .. | **High Wycombe** (38) |
| ..... | 1,045 kw. | Welsh coal | £42,690§ | £42,641 | 5/5 | 25,327 ..... | 220 v. .... | 23 = 36 kw. .. | §Exclusive of mtrs. and demand meters, £6,716 | C. Bottomley Smith | **Hove** .....(39) |
| ..... | 23 kw. | Water power | £3,500 (about) | | — | 70 200 v. ..... | 100 v. and 200 v. | — | Mains sup. through battery of 116 27 plate D.P. cells | H. W. Brotherton | **Ingleton** .....(40) |
| erranti | 150 kw | Screened nuts | £26,160 | £9,660 | — | None ..... | 100 v. .... | 1 = 5 h.p. for driving mechanical stoker | — | A. D. Brigham | **Kelvinside** ....(41) |
| d omson | 200 kw. | Anthracite pea nuts | £29,500 | — | — | All..... | 200 v. .... | 2 = 1½ h.p..... | — | J. Pilling ..... | **King's Lynn** ....(42) |
| okham | 420 kw. | Burgie .... | £28,662 | | 5/1½ | None ..... | 100 v. and 200 v. | About 35 = 150 h.p. | — | W. A. Fraser .. | **Lancaster**.....(43) |
| ..... | 304 kw. | Coal ..... | — | — | 6/2 | — | 118 v. .... | — | — | F. W. E. Jones | **Leamington** ....(44) |
| l Aron | 428 kw. | Washed pearls | £30,000 (in mains) | £7,900 | — | — | 230 v. and 460 v. | 15 = 151 h.p... | — | W. A. Bryson, consultg. & res. engineer | **Leith** .....(45) |
| omson, am | 578 kw. | Welsh anthracite & hard steam | £59,478 | £20,000, service £4,200 | 5/6 | None ..... | 150 volts .. | 8 = 7 h.p. .... | Steam plant, temp. bldgs. in progress to take stm. plant | F. Harman Lewis | **Leyton** .....(46) |
| attner | 598 kw. | Coal ..... | £32,000 | £9,000 approx. | — | — | 230 v. .... | 10 h.p. ..... | — | C. S. V. Brown | **Lincoln** .....(47) |
| nd erranti | 7,090 kw. | Slack .... | — | — | — | — | 230 v. .... | 219 = 740 h.p. | — | A. Bromley Holmes | **Liverpool** .....(48) |
| rranti | — | Coke..... | £25,000 | — | — | — | 220 v. .... | — | — | Harold Morton | **Llandudno** ....(49) |
| Hookastian c | 49 kw. | Small coal, ref. collected from streets | £2,000 | | Cannot yet be stated | All ..... | 220 v. .... | ½ h.p., ¼ h.p. .. | — | W. Jas. Price | **Maerdy (Glamorganshire)** (50) |
| omson- Aron, in- kham | 6,000 kw. | Washed slack | £263,620, excluding mains to Mr. 31, '99 | £230,096 | 3/5 | A considerable number | 100 v., 200 v., 300 v. or 400 v. | 464 = 1,704 h.p. | Plant on order 4 1,800 kw., 2 750 kw., all direct driven | C. H. Wordingham | **Manchester** ....(51) |
| d kham | — | Welsh steam coal | — | — | — | — | — | — | — | J. G. Hill..... | **Mevagissey** ....(52) |

| | | | | | | |
|---|---|---|---|---|---|---|
| **(38) High Wycombe** | W. (Boro) Electric Light & Pwr. Co., Ltd. | 3 wire | 3 Davey-Paxman's economic | 2 (Peache) 150 h.p. each, 1 (Peache) 250 h.p. | Parker | 2 72 |
| **(39) Hove** | Hove Electric Light Co. | 3 wire 220 v. | 2 Lanc., 4 water tube | 3 (Willans) 100 h.p., 2 do. 250 h.p., 2 do. 360 h.p., 1 do. 38 h.p., 1 (Belliss) 150 h.p. | Crompton | 3 60<br>90<br>1 9 |
| **(40) Ingleton** | Company | 3 wire triple con. feeders, 3 core distrb. | — | 2 (Gilkes) vortex turbines, 16 to 20 h.p. | Hall | 35 t<br>to |
| **(41) Kelvinside** | Glasgow Corporation | 2 wire | 2 water tube | 2 (Willans) 125 h.p. | Goolden | 2 75 |
| **(42) King's Lynn** | Council | 3 wire 400 v. across outers | 4 Dowson gas producers | 5 gas engines 65 b.h.p. each | 2 pole, 400 volts | 40 k |
| **(43) Lancaster** | Corporation | 3 wire | 3 Lanc. | 1 (Willans) 350 h.p., 1 (Willans) 200 h.p., 1 (Willans) 135 h.p., 1 (Willans) 60 h.p. | 3 Brush, 1 Mather and Platt | 1 12<br>1 3 |
| **(44) Leamington** | Midland Elec. Light & Pwr Co., Ltd. | 2 wire | 3 Loco. | 2 horiz. 250 h.p., 1 horiz. 30 h.p. | Chamberlain and Hookham | 4 80 |
| **(45) Leith** | Town Council | 3 wire | 3 Lanc., 160 lbs. | 4 (Belliss) 150 h.p., 1 do. 100 h.p. | Silvertown horse-shoe 2 pole inverted machines | 4 92 |
| **(46) Leyton** | District Council | 3 wire 300 v. | 5 gas generators and 250 h.p. blrs. | 4 (Wells) gas engines, 60 b.h.p., 4 do. 85 b.h.p., 1 (Willans) 350 i.h.p. | Fuller-Wenström, E.C.C., General Electric Co., and Mather & Platt | 4 85<br>1 2 |
| **(47) Lincoln** | Corporation | 3 wire, 460 v. | 4 Dryback, marine type | 3 (Willans) 80 i.h.p., 2 (Willans) 820 i.h.p. | Laurence, Scott & Co | 3 of<br>kw |
| **(48) Liverpool** | Corporation | 2 and 3 wire | Lanc. | Willans 300 h.p. and 1,200 h.p. | Siemens and E.C.C. | 160 |
| **(49) Llandudno** | Urban District Council | 3 wire 440 v. | Babcock, 2 comb. with dust destrc. | 2 150 h.p., 1 75 h.p. | Shunt wound | 2 10 |
| **(50) Maerdy (Glamorganshire)** | — | 2 wire | Locomotive type | 1 (Robey) steam comp., 56 b.h.p. | Shunt-wound dynamo | 39 kv |
| **(51) Manchester** | Corporation | 5 wire and 3 wire | 18 Lanc. 4 Babcock & Wilcox | 12 400 h.p., 2 2,500 h.p. | 12 bi-polar, 2 multi-polar | 12 25<br>kw. |
| **(52) Mevagissey** | Mevagissey Electric Ltg Co., Ltd. | 2 wire | Loco. | Semi-portable 30 h.p. | Crompton | 26 kv |
| **(53) Middleton** | Middleton Elec. Lgt. and Power Co. | — | Lanc. | 1 horizontal 20 h.p. | 2 Wilson | |
| **(54) Nelson** | Corporation | 2 wire | 2 | Willans | —— | 93 kv |
| **(55) Newington** | Vestry | 3 wire | 4 Babcock-Wilcox | 1 (Willans) 150 h.p., 2 do. 350 h.p., 1 do. 750 h.p. on order | 4 Johnson and Phillips 4 pole slotted armatures, 1 6 pole on order | 1 88<br>1 40 |
| **(56) Northampton** | Northampton Elec. Light and Pwr. Co. | 3 wire | 3 Lanc., 2 Babcock & Wilcox | 3 (Scott) 120 h.p., 1 (Willans) 80 h.p., 1 (Belliss) 40 h.p., 2 (Willans) 240 h.p. | Crompton and 1 E.C.C. | 2 64<br>1 25<br>2 12 |
| **(57) Northwich** | Northwich Elec. Supply Co., Ltd. | 3 wire, L.T. | — | 3 gas engines, each 100 b.h.p. | Overtype shunt dynamos | 60 kv |
| **(58) Norwich** | Norwich Elec. Supply Co. | 3 wire | Babcock | 3 (Willans) 100 i.h.p., 3 do. 135 i.h.p., 2 do. 200 i.h.p., 3 do. 300 i.h.p. | Norwich | 6 30<br>2 12 |
| **(59) Nottingham** | Corporation | 3 wire | 8 Lnc., 5 mul.-tub. Dryback | 3 (Willans) 80 h.p., 7 do. 134 h.p., 4 do. 360 h.p., 3 do. 700 h.p. | Siemens | |
| **(60) Ogmore Valley** | Ogmore Valley Elec. Lgt. & Power Co. | 2 wire | Loco. type tubular | 2 35 h.p. undertype | J. C. Howell | 1 200<br>amp |
| **(61) Oldham** | Corporation | 2 and 3 wire | 8 Lanc. | 2 (Willans) 60 h.p., 2 do. 100 h.p., 2 do. 200 h.p., 4 do. 360 h.p. | Charlesworth Hall, and Siemens | 2 36<br>2 12 |
| **(62) Oswestry** | Oswestry Elec. Lgt. and Power Co. | 2 wire at 220 v. | 2, 1 Babcock and Wilcox | 2 (Marshall), 1 (Belliss) | 2 Parker, 1 Siemens direct coupled to engine | 2 30 k |
| **(63) Pontypool** | Pontypool Elec. Lgt. and Power Co. | 2 wire | 3 Marshall loco. type | 1 (Willans) 90 i.h.p., 2 (Willans) 60 i.h.p., 1 (Willans) 25 i.h.p. | Crompton and Parker | 2 34 k<br>70 k |
| **(64) Preston*** | National Elec. Supply Co., Ltd. | 3 wire con. at 220 v., H.T. alternating | 6 Lanc. multitubular | 7 (Belliss) 100 b.h.p., 1 (Belliss) 200 b.h.p., 2 (Belliss) 330 b.h.p. | Westminster, Siemens, and E.C.C. | 9 66<br>2 16<br>alter |
| **(65) Richmond (Surrey)** | Richmond Elec. Lgt. and Power Co. Ltd. | 3 wire | 3 Penman multitub., 2 Pax. econ. | 3 100 h.p., 2 60 h.p., 2 200 h.p., Universal | Latimer Clark, Muirhead & Co., Mordey | 3 67 k<br>130 |
| **(66) Rottingdean** | New Rottingdean Electricity Co. | 2 wire at 100 volts | 1 water tube, 1 Davey-Paxman | 1 (Browett) 25 h.p., 1 (Shanks) 8 h.p., 1 (Belliss and Morcom enclosed) 38 h.p. | 1 (Flather) multi-polar, 1 (Silvertown) shunt wound, Crompton | 1 200<br>amp |
| **(67) Salisbury** | Salisbury Elec. Light and Supply Co. | 3 wire | 2 Babcock | Water power, 1 (Gilkes) turbine, 60 h.p., Belliss-Parker set 84 kw., 180 amp., 460 v., 420 revs.; 1 new Belliss-Parker set 92 kw. erecting | Parker. 2 boosters 70 v., 70 amps., 2 machines 230 v., 100 amps., all on one shaft; 1 84 kw., 1 92 kw. erecting | Turbi<br>revs.<br>by g<br>to ba |
| **(68) St. Austell** | Veale & Co. | 2 wire | Loco. type | 3 compound | 1 Crompton, 2 Kapp, 1 Veale | 1 44<br>1 9 |
| **(69) Shrewsbury** | Corporation | 3 wire at 420 between outers | 4 water tube, 2 Lanc. | 3 (Belliss) 50 i.h.p., 2 (Belliss) 150 i.h.p. | Parker | 3 33 |
| **(70) Southampton*** | Corporation | 3 wire, 100 and 200 v., and alterg. trans. 2,000 to 200 | 1 Lanc., 6 Babcock | 3 (Willans) 180 h.p., 2 (Willans) 150 h.p., 1 (Belliss) 140 h.p., 2 (Willans) 100 h.p., 1 (Willans) 60 h.p. | Crompton | 3 120<br>1 90<br>1 30<br>moto |
| **(71) Stafford** | Corporation | 3 wire | 3 Lanc. | 3 (Marshall) | E.C.C. | 3 66 k |
| **(72) Stockport** | Corporation | 3 wire | Lancs. | 3 (Willans) 90 h.p., 2 (Willans) 240 h.p. | McClure and Whitfield | 56 and |
| **(73) Stockton** | Council | 3 wire | 3 Galloway | 3 Universal | Brush multi-polar | 2 150 |
| **(74) Sunderland** | Corporation | 3 wire, 110 v. 220 v. | 6 Lanc. 2 water tube, 2 Galloway | 4 (Belliss) 400 h.p., 5 (Belliss) 200 h.p., 2 (Willans) 50 h.p. | Holmes, Parker, Crompton, Sunderland Forge & Silvertown | 2 26 k<br>4 215<br>moto |
| **(75) Ventnor** | Ventnor Elec. Light and Power Co. | 3 wire | Babcock and Wilcox | 2 (Belliss) compound 110 b.h.p. each | Parker 2 pole | 84 kw. |
| **(76) Whitehaven** | Corporation | 3 wire | Lanc. | 6 (Willans) 60 h.p. | Crompton | 35 kw. |
| **(77) Winchester** | Elec. Ltg. Co. | 3 wire | 3 Babcock | 2 (Belliss) 80 h.p., 1 (Belliss) 300 h.p. | Parker | 2 115<br>amps |
| **(78) Windsor** | Windsor Elec. Instlln. Co., Ltd. | 3 wire | 2 Lanc., 2 Dy.-Pxmn. economic | 2 (Peache) 200 i.h.p., 1 do. 100 i.h.p., 1 do. 160 i.h.p., 1 (Belliss) 400 i.h.p. | Siemens | |
| **LONDON.** | | | | | | |
| **(79) Barking** | Urban District Council | 3 wire | Babcock and Wilcox | 1 60 h.p., 2 130 h.p. | Sunderland Forge (engines and dynamos) | 2 20 k |
| **(80) Chelsea** | Chelsea Electricity Supply Co. | 3 wire | Water tube | Willans | E.C.C. | 80 kw.<br>kw. |
| **(81) Kensington Court Works** | Kensington & Knightsbrdg. Elec. Ltg. Co. | 3 wire | 6 water tube B. and W. 1,500 h.p. | 9 (Willans) 1,910 h.p., 7 (Willans) 250 h.p., 2 (Willans) 80 h.p. | Siemens and Crompton | 50 and |
| **(82) London** | Smithfield Markets Elec Supply Co. | 3 wire | 4 economic | 4 Windsor engines 250 h.p. each | 4 pole | 125 kw |
| **(83) Notting Hill** | Notting Hill Elec. Ltg. Co. | 3 wire | Water tube | Willans | Crompton and Siemens | 120 and |
| **(84) St. James's Parish** | St. James's and Pall Mall Elec. Lt. Co. | 3 wire | Economic, Loco., and water tube | Willans 6,000 h.p. | Siemens | |
| **(85) St. Martin's in the Fields, Strand District, South Holborn and St. Giles** | Charing × & Strand Elec. Supply Co. | 3 wire at 100 and 200 volts | 17 watr. t'be. 2 marine | 5 (Willans) 200 h.p., 1 (Willans) 130 h.p., 2 (Willans) 80 h.p., 12 (Belliss) 500 h.p. | Mather and Platt, and Siemens | 5 100 k<br>2 40 kv |
| **(86) St. Pancras** | Vestry | 3 wire, 110 and 220 v., 3 wire, 440 v. | Water tube Lanc. and 3-flue mar. | 17 (Willans), 3,080 i.h.p., 3 (Belliss) 660 i.h.p., 1 (Peache) 250 i.h.p. | Kapp, Latimer, Siemens, and Crompton | 50 to 5 |
| **(87) Westminster and St. George's** | Westminster Elec. Supply Corpn., Ltd. | 3 wire | Paxman and Babcock | Willans, up to 361 i.h.p. | E.C.C., Crompton, Siemens, and Goolden | Up to |
| **(88) Whitechapel** | District Board of Works | 3 wire at 240 v. and 480 v. | 2 Babcock, Destrctr. blr. as reserve | 1 (Willans) 200 i.h.p., 1 do. 450 i.h.p. | Mather and Platt 4 pole | 2 60 k<br>on sn<br>275 kv |
| **(89) Woolwich†** | Woolwich District Elec. Light Co. | 4 feeders to net work of distributors | 4 loco., 1 Dy. Pax. econo. bng. put dn. | 2 (Parsons) trbns. 110 kw., 1 (Allen) enclosed 100 kw., 1 (Bumstead-Chandler) enclosed 110 kw. | Parsons 2 pole, Allen 2 pole, E. A. & G. multi-polar | 3 110<br>100 k |
| **PROVINCIAL.** | | | | | | |
| **(1) Barrow-in-Furness** | Corporation | 1,100 v. feeders 220 v. distrb. | 3 Babcock-Wilcox | 3 (Universal) 75 kw. | 4 pole Universal | 75 kw. |
| **(2) Bridlington** | Town Council | Series | — | Otto gas engine 20 h.p., nom. 42 b. | Thomson-Houston series | 18 arc |
| **(3) Hull** | Corporation | H.P. con. with trans. & aux. L.T. plnt. | 4 mar. Dry-bk., 6 Lancs., 1 water tube | 2 (Willans) 80 h.p., 2 do. 200 h.p., 2 do. 300 h.p., 2 do. 100 h.p., 2 do. 360 h.p., 2 (Allen) 800 h.p. | Siemens, Holmes, 2 Parker, 220 v., 4 do., 2,250 v. | 2 44 kw<br>2 180<br>2 202 |
| **(4) Keynsham** | Keynsham Elec. Lgt. & Pwr. Co., Ltd. | Series for streets, parallel | 2 48 i.h.p. Economic | 2 12 nom. h.p. (Davey-Paxman) indicating 36 i h.p. | Johnson and Phillips, and Taunton | 2 9·5 u |
| **(5) Londonderry** | Corporation | Series | Penmans' Lanc. | 3 compound cond., 150 h.p. | Siemens | 6 30 kw |
| **(6) Morecambe** | Urban District Council | 1,400 v. | Babcock-Wilcox and Lanc. | 3 (Peache-Parker) 125 i.h.p., 2 15 i.h.p., 1 (Par.) turbine 900 h.p. | Parker bi-polar, Parsons bi-polar | 3 90 kw |

HIGH

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ..... | 2 72 kw., 1 150 kw. | Direct coupled | Non-condensing | with bitumen Callender's triple con. feeders, cbls. lead cov. & armd. | 17 arcs 7,236 8 c.p. | 5 arcs, 220 16 c.p. incandscnt. | 6,000.... | power Ltg. 7d., 4d. & 2d., motors 4d. and 1½d. | Wright's max. demand | mand indicator Ferranti, Chamberlain-Hookham, and Aron | 194 kw. | nuts Hard steam coal | £32,415 | 10,000 | 5/3 | 7,686... |
| ..... | 3 60 kw., 1 154 kw., 1 90 kw., 2 222 kw., 1 23 kw. | Direct .. | Non-condensing | In culvrts., and i.r. cable in c.i. pipes | 44,892, 33 watt | 20 8 c.p. incandescnt. | 7,925.... | 8d. first hour, 4d. after, discounts | Brighton | Ferranti ..... | 1,045 kw. | Welsh coal | £42,690§ | £42,641 | 5/5 | 25,327 . |
| ..... | 35 to 45 amps., 330 to 250 v. | Belts.... | — | Callender's, lead sheathed and steel armoured | 400 incand. | 32 32 c.p... | 500 .... | 6d. per unit | Meters & contract | Schattner ..... | 23 kw. | Water power | £3,500 (about) | | — | 70 200 v. |
| ..... | 2 75 kw. ..... | Direct .. | — | Callender's armoured | 11,344 8 c.p. | — | 2,098.... | 6d. lighting, 3d. power | No rebate | Kelvin and Ferranti | 150 kw | Screened nuts | £26,160 | £9,660 | — | None . |
| olts ..... | 40 kw. ..... | Belts.... | — | Con. fdrs. lead. sh, partly cond, partly arm'd laid direct | 12 arcs, 5,750 8 c.p. incandsnt. | 14 arcs, 1,250 8 c.p. incandsnt. | All..... | 5½d. | Uniform charge | Ferranti and Thomson | 200 kw. | Anthracite pea nuts | £29,500 | — | — | All..... |
| Vather and Platt | 1 120 kw., 1 80 kw., 1 36 kw., 1 180 kw. | Direct .. | Condensing.... | Callender's bitumen cable | In Mar. 1899, 17,807 8 c.p. | To date, 29 arcs, 55 incandsnt. | From Mar. 25 to Dec 31, 3,210 | 4½d. lighting, 3d. power | 5 % disct. | Principally Hookham | 420 kw. | Burgie .... | £28,662 | | 5/1½ | None . |
| and Hookham | 4 80 kw., 1 30 kw... | Ropes and belts | Condensing.... | Callender's, brick culverts and also armoured feeders | 8,448 8 c.p. | — | 1,700.... | 7d. to 5d. | Rd. aft. 12 units pr. 16 c.p. pr. qtr. | Hookham ..... | 304 kw. | Coal ..... | — | — | 6/2 | — |
| orse-shoe 2 pole achines | 4 92 kw., 1 60 kw... | Direct .. | Non-condensing | B.I.W., laid direct in grnd. with steel protection plates | 14,000 8 c.p. | 105 arcs | 14,000, b'n running a year | 5d. unit ltg., 1½d. power | Meter .. | Ferranti and Aron | 428 kw. | Washed pearls | £30,000 (in mains) | £7,900 | — | — |
| ström, E.C.C., lectric Co., and Platt | 4 85 kw., 4 52 kw., 1 230 kw. | Belts and dir. cpld. steam | Non-condensing | Siemens' conc. in Doulton con. arm. West Elec., Call. | 85 arcs, 18,000 8 c.p. | 12 arcs, 267 incandescent | 9,131.... | 5d. 1st 1½ hr., 2d. aft. ltg. 5d. 1st hr, 1d. aft. pr. | Brighton | Ferranti, Thomson, and Hookham | 578 kw. | Welsh anthracite & hard steam | £59,478 | £20,000, service £4,200 | 5/6 | None . |
| cott & Co ..... | 3 of 66 kw., 2 of 200 kw. | Direct coupled | Ejector condensers | Armrd. conc. and triple conc. laid in bitumen | About 11,000 8 c.p. | 30 arcs, 60 incand. | — | 6d. 1st hr's av. dmand. p. day p. qtr., 2½d. aft. | — | Ferranti and Schattner | 598 kw. | Coal ..... | £32,000 | £9,000 approx. | — | — |
| E.C.C. ..... | 160 kw. and 600 k.w. | Direct .. | Condensing and non-condensing | Callender's solid .. | 117,773 16 c.p. | 142 arcs .. | 26,652 16 c.p. | 4d. lighting, 2d. and 1d. power | — | Hookham and Ferranti | 7,090 kw. | Slack .... | — | — | — | — |
| ..... | 2 100 kw., 1 50 kw. | Direct .. | Ledward evaporative condrs. | Triple con. feeders, 3 core distribtrs. | 12,000 8 c.p. | 48 arcs, with incan. bkts. on 4 poles | Started Nov. 5, 1898 | 6d. per unit (Scale A) | 7d. 1st hr., 3½d. aft. (Scale B) | Bastian and Ferranti | — | Coke..... | £25,000 | — | — | — |
| dynamo ..... | 39 kw. ..... | Leather belting | Non-condensing | Bare wire overhead | 1,000 8 c.p., 6 arcs | None yet .. | 200 ..... | 4½d. per unit | Meter and per lamp | Chambrln.-Hookham and Bastian Electrolytic | 49 kw. | Small coal, ref. collected from streets | £2,000 | | Cannot yet be stated | All ... |
| multi-polar .. | 12 250 kw., 2 1,500 kw. | Belts and direct | Condensing.... | Bare cop. con. cul., vul. rub. in p. vul. rub., vul bit., & ld. cov. paper, laid sol. | 2,095 arcs, 222,176 8 c.p. incandescent | 29 arcs .... | 46,636 .. | 5d. or £7 kw., inst. plus 1½d. unit, spcl. pwr. rts. 1½d. or 2½d. | Hopkinson | Ferranti, Thomson-Houston, Aron, Chamberlain-Hookham | 6,000 kw. | Washed slack | £263,620, excluding mains to Mr. 31, '99 | £230,096 | 3/5 | A consid number |
| ..... | 26 kw. ..... | Belt .... | Non-condensing | Overhead wire .. | — | 36 incndsnt. | 80 ..... | 6d. per unit | — | Thomson and Hookham | — | Welsh steam coal | — | — | — | — |
| ..... | — | Belt .... | Non-condensing | Overhead and i.r. cables in pipes | 8 arcs, 900 incandescent | — | — | — | By contract | — | 66 kw. | Coal ..... | — | — | — | — |
| — | 93 kw. ..... | Direct .. | — | Lead cov. vul. cbs. in c.i. pipes, con. earthen. troughs | 5,900 8 c.p. | 4 arcs .... | 760 .... | 5d. lighting, 2d. power, 5% off | Discounts | Ferranti, Chamberlain and Hookham | 100 kw. | Coal and coke | £4,500 | £5,600 | 5/6 | — |
| d Phillips 4 pole atures, 1 6 pole | 1 88 kw., 2 165 kw., 1 400 kw. on order | Direct .. | Non-condensing | Lead cov. dist. laid solid, fdrs. lead cov. in conduits | Equivlnt. of 8,500 8 c.p. | 90 arcs, 180 32 c.p. incandescnt. | — | 6d. and 4d., 3d. after; also discnts. | Maximum demand | Thomson-Houston | 418 kw. | Pea size coking coal | £50,000 | — | — | — |
| d 1 E.C.C. .... | 2 64 kw., 1 68 kw., 1 25 kw., 1 44 kw., 2 120 kw. | Direct and ropes | Non-condensing | Bare strip ..... | 19,763 8 c.p. | 2 arcs .... | 6,702.... | 6½d. and 3½d. 5% dis., 3½d. & 1½d. motor pr. | Brighton | Hookham ..... | 505 kw. | Coal and slack | £31,000 | | 6/10 | — |
| nt dynamos .. | 60 kw. ..... | Belting.. | — | Paper ins., triple conc. and armd., laid direct in gnd. | 6,186 8 c.p. | Equivalent 88 8 c.p. | 2,301.... | 6d. per unit 1st hour, 4d. after | Brighton | Chamberl'n-Hookham, Aron and Long-Schattner | 180 kw. | Mond producer gas | — | — | — | — |
| ..... | 6 30 kw., 3 81 kw., 2 125 kw., 3 187 kw. | Direct .. | Separate Körting condenser to each engine | Bare copper in culverts | 243 arcs, 25,900 16 c.p. | — | 9,800 .. | 5d. | — | Scott, Hookham and Schattner | 1,234 kw. | Coal ..... | £45,500 | £44,200 | 7/9 | Outlying |
| ..... | — | Direct .. | — | Callender's ..... | 86,000 equiv. 8 c.p. | 15 arcs .... | — | 4d. to 2d. ltg., 1d. power | Brighton | Ferranti and Hookham | 2,940 kw. | Coal ..... | £127,393 (31 Mar. 1899) | | 4/10 | — |
| ..... | 1 200 amps., 1 300 amps., 5 70 amps. | Belt .... | Non-condensing | Overhead wires .. | 1,000 16 c.p. | 180 incand. | 100 .... | 6d. and 8d. | Contract chiefly | Ferranti ..... | 350 amp. | Small coal | £5,565 | | 8/9 and 12/6 | None . |
| Hall, and | 2 36 kw., 2 60 kw., 2 120 kw., 4 225 kw. | Direct .. | Condensing.... | Bare strip & rub. & pap. cabs. in iron pipes & bit. cabs. | 32,281 8 c.p. | 28 arcs .... | 5,900.... | 4d. & 2d. priv. customers 2½d. street lgt. | Brighton 2 hours | Ferranti ..... | 1,332 kw. | Slack coal | Capital expenditure £67,600 | | 5/3 | All..... |
| Siemens direct ngine | 2 30 kw., 1 33 kw. .. | Ropes and direct driven | Non-condensing | Callender's armoured cables | 4,000 8 c.p. | — | 180 .... | 7d. | Meter .. | Hookham and Ferranti | 93 kw. | Coal ..... | £5,867 | | 3/4 | All..... |
| d Parker ..... | 2 34 kw., 1 13 kw., 1 70 k.w. | Direct .. | Non-condensing | Copper strip, and Callender's armoured | 23 arcs and 5,202 8 c.p. | — | 508 .... | 6d. lighting, 3d. power | By meter | Ferranti and Hookham | 151 kw. | Small coal washed | £8,741 | £1,051 | 5/0½ | None . |
| Siemens, and | 9 66 kw., 2 225 kw., 2 16·5 kw. motor alternators | Direct .. | Non-condensing | Bare strip cable in pipes and arm'rd H.T. concentric | 40,102 8 c.p. | 42 arcs, 10 amps. | 9,252.... | 7d. and 4d., less 15 % for cash | Brighton | Ferranti and Hookham | 1,044 kw. | Small slack | — | — | — | — |
| rk, Muirhead & | 3 67 kw., 2 45 kw., 2 130 kw., 230 v. | Direct .. | Non-condensing | Bare strip, and Henley, Silvert'wn. and Glover cable | 14,310 8 c.p. | — | 1,930.... | 7d., after Apl. 6d. lighting, 4d. power | — | Ferranti ..... | 540 kw. | Welsh coal | £18,663 | £14,845 | 9/- | None . |
| multi-polar, 1 shunt wound, | 1 200 amps., 1 230 amps. | Belt and direct | Non-condensing | B.I.W. paper insulation lead cov. in pipes | 600 8 c.p. | 14 25 c.p. .. | 100 .... | 6d. | — | Ferranti ..... | — | Welsh coal | — | — | — | — |
| oosters 70 v., 70 achines 230 v., ll on one shaft; 2 kw. erecting 2 Kapp, 1 Veale | Turbine runs at 28 revs., and is coupled by gearing & belting to balance set 1 44 kw., 2 21 kw., 1 9 kw. | — Belts and counter shafting | Wright's heater condenser Non-condensing | Callender's 3 core distrbtrs., T.C.C. feeders Parallel ..... | 148 consumers, 6,228 8 c.p. equiv. 8 arcs, 2,000 incan. | None .... — | 91 consumers, 4,059 — | 7d., 4d. and 2d. — | Rebate .. Rebate 6½d., 3½d. | Ferranti, Hcokham, and Schattner Chamberlain and Hookham | 166 kw. 95 kw. | Farringdon small coal, 10/3 per ton delivered Coal ..... | £27,203 £6,000 | £5,506 — | 6/3 — | All..... — |
| ..... | 3 33 kw., 2 100 kw. | Direct .. | Non-condensing | Callender's armoured cables | 8,394 .... | 4 arcs, 24 fixing | 2,894.... | 7d., 4d. and 2d. | Brighton | Thomson, Ferranti, and Chamb'lain-Hookham | 299 kw. | Coal ..... | — | — | 7/3 | All..... |
| ..... | 3 120 kw., 2 100 kw., 1 90 kw., 2 60 kw., 1 30 kw., 1 60 kw. motor | Direct .. | Non-condensing | Bare strip, diatrine con. for altern. mains | 18,000 8 c.p. | 62 arcs .... | 7,337.... | 6d. lighting, 3d. power | Brighton | Ferranti, Hookham, Aron, and Shallenberger | 780 kw. | Small coal | £55,000 | | 8/3 | None . |
| ..... | 3 66 kw. each ..... | Rope .. | Jet condenser .. | Vulcanised rubber in Doulton conduits | 7,500 8 c.p. | 4 arcs .... | 500 .... | 7d. & 3d. ltg. 3d. power | Brighton | Hook'm, Ferranti, and Thomson-Houston | 198 kw. | Coke breeze coke, and rough slk. | £20,000 | £4,000 | 3/11 | Very fe |
| Whitfield .... | 56 and 140 units.... | Direct .. | Non-condensing | Armoured ..... | — | 32 arcs.... | 7,700.... | 5d. | Direct .. | Ferranti, Reason, and Bastian | 450 kw. | Coke breeze | — | — | — | — |
| olar..... | 2 150 kw., 2 25 kw. | Direct coupled | Non-condensing | Con. & triple con., arm. bit. cbls laid in wood troughs | — | — | — | — | — | — | — | — | — | — | — | — |
| ker, Crompton, Forge & Silver- | 2 26 kw., 5 125 kw., 4 215 kw., 2 38 kw., motor | Direct .. | Non-con.; Wh'el'r surf. con. & cool. tower fixing | Bare strip, Silvertown and Callender's solid | 35,027 8 c.p. | 50 arcs .... | 11,000 .. | 5d. lighting, 2½d. power | Brighton | Ferranti and Thomson-Houston | 1,540 kw. | Small coal Durham | £41,000 | £31,000 | 5/1 | About h wired |
| ..... | 84 kw. ..... | Direct .. | Non-condensing | Callender's triple conc. fdrs. 3 core dis., steel arm'd. | — | 24 arcs, 100 incandsnt. | 3,800.... | 7d. first hour, 4d. after | Wright's max. demand | Ferranti ..... | 168 kw. | Steam coal | — | — | — | — |
| ..... | 35 kw. ..... | Direct .. | Condensers (Ledward) | I.R. cables in earth. pipes and lead cov. B.I.W. Co. sol. sys. | Equivalent 9,024 8 c.p. | 452 incndsnt. 10 arcs | 2,550.... | 5d. unit, £6 an. kw. max. dem. 2d. per unit | — | Hookham, Ferranti, and Aron | 210 kw. | Washed nuts | £20,275 | £9,261 | 8/1 | About 5 |
| ..... | 2 115 amps., 1 410 amps. | Direct coupled | Non-condensing | Tri. con. feeders, 3 core dis. | 10,000 .... | — | 6,228.... | 7d., 5d. and 2d. | Wright's | Ferranti ..... | 293·5 | Welsh sm'keless steam coal | £20,335 | £6,280 | 3/6 | 2,705 lan units |
| ..... | — | Direct .. | Non-condensing | Triple concen. armoured | 27 arcs, 7,527 8 c.p. | 290 16 c.p., 34 arcs | 7,000 .. | 6½d., motors 4d. per unit | 50 % reb. af. ern. 12s. 8 c.p. an. | Ferranti, Hookhm., Thomson-Hston., Aron, and Bastian | 625 kw., without cells | Anthracite peas, Powell Duffryn | £23,000 | £19,000 | — | 1,580 8 |
| Forge (engines s) | 2 20 kw., 2 100 kw. | Direct .. | Non-condensing | Net work, 3 wire.. | 5 arcs .... | 14 arcs, 181 costs 2 10 c.p. each (a) | 4,254, from May, '99 | 6d. and 2d. .. | Demand indicator | Thomson-Hstn., Bastian, Long-Schttnr. (prepay.) | 240 kw. | Welsh coal | Not finished | | Not yet run full year | — |
| ..... | 80 kw., 150 and 200 kw. | Direct .. | Non-condensing | Callender's in stoneware casings | 129,000 8 c.p. | — | 16,000 .. | 6d. to 3d. lighting, 3d. power | Brighton | Hookham and Ferranti | 3,060 kw. | Welsh coal | — | — | 5/8 | All new tions |
| Crompton .... | 50 and 150 kw. .... | Direct .. | Condens. (Ledward evap., Edwards air p'mps) | Ld. cov. pap., rub. cables in iron pipes & bare strip in cul. | 183,462, inclu. Knightsbridge Wks. | 1 arc..... | 29,724 .. | 6d. at 100, 5d. at 200, 4d. power | Rebates | Aron, Ferranti and Hookham | 1,000 kw. | Welsh coal | £263,481 both works whole and system | | 6/– | 120,727. |
| ..... | 125 kw. each ..... | Direct .. | Non-condensing | Bare copper and Callender's bitumen | Equivalt. of 17,432 8 c.p. | — | 6,896.... | 6d. to 3¾d. (b) | Sliding scale | Hookham ..... | 600 kw. | Welsh steam coal | — | — | 12/11 | 1,027 8 |
| Siemens .... | 120 and 200 kw..... | Direct .. | Non-condensing | Cables and bare strip, in Doulton conduits | 35,500 8 c.p. | — | 1,608 8 c.p. | 8d. at 100, 6d. at 200, 4d. day load | By meter | Aron, Ferranti, and Hookham | 620 kw. | Welsh coal | £31,107 | £52,637 | 6/5 | About 8 con |
| ..... | — | Direct .. | Non-condensing | Callender's bitu.. Siemens, bare copr., and B.I.W. | 163,650 8 c.p. | 61 arcs .... | 21,897 .. | Ltg. 6d. to 4d., less 8 %, pwr. 3d. | 1st 4,000 6d., aft. 4d., less 8 % | Hookham, Ferranti, Aron, and T. H. | 3,880 kw. | Coal ..... | — | — | 9/2 | — |
| Platt, and Siemens | 5 100 kw., 1 75 kw., 2 40 kw., 12 250 kw. | Direct .. | Non-condensing | Callender's in casing, armoured and paper cables | 182,689 8 c.p. | — | 48,453 .. | 6d. lighting, 4d. power | Sliding scale | Aron, Ferranti, and Hookham | 3,555 kw. | Welsh coal | — | — | — | Insignifi |
| r, Siemens, and | 50 to 500 kw. ..... | Direct .. | Condensing.... | Bare strip and armoured cable | 110,462 8 c.p. | 230 arcs. .. | 20,276 8 c.p. | Indictr. systm., 6d. 1st 1½ hs., 3d. after | Brighton, optional | Aron, Hookham, Ferranti, and Thomson | 2,590 kw. | Coal ..... | Approximately £112,419 inclu. lanc | £129,574 | 7/6 | |
| pton, Siemens, | Up to 225 kw. .... | Direct .. | — | Armoured, strip and casing | — | 12 arcs .... | 427,000.. | 6d. lighting, 3d. pwr., with rebates | Rebates and discounts | Aron, Ferranti .. | 6,100 kw. | Welsh coal | — | — | (c) .... | All new con |
| att 4 pole .... | 2 60 kw. in tandem on small engine, 1 275 kw. on large eng. | Direct .. | Non-condensing | B.I.W. solid, 3 single mains | — | 50 arcs .... | — | 8d. 1st hr., 1d after | Wright's | Reason..... | 395 kw. | Welsh .... | — | — | — | — |
| e, Allen 2 pole, ulti-polar | 3 110 kw. each, 1 100 kw. | Direct and belts | Surface cndnsg. (Thames water us'd for cooling) | Cllndr.'s ld, cov. ar., 3 core dis. tpl. fdrs., vul. bit dis. c.i. ps. | 10,023 .... | — | 5,203.... | 6d. light, 3d. power | 5 % in 14 days | Ferranti and Aron | 430 kw. | Welsh coal | — | — | 6/11 | — |

# H PRESSURE CONTINUOU

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| al ..... | 75 kw. ..... | Direct .. | Non-condensing | B.I.W. conc. .... | Dec. 31, '99, 9,237 | 22 10 amp. arcs, 44 16 c.p. incan. | 9,237 .... | 6d. 2 hs., 3d. aft. ltg., 6d. 1 hr., 1½d. aft. pwr. | Brighton | Ferranti and Cham.-Hookham | 225 kw. | Coal ..... | £29,000 (approx.) | — | — | 9,237... |
| ston series.... | 18 arc lighter ..... | Belt .... | — | British Insulated Wire Co.'s, lead covered | — | 17 arc, 3 32 c.p. incandescent | — | — | — | — | 18 arcs | Gas ..... | — | — | — | — |
| nes, 2 Parker, 2,250 v. | 2 44 kw., 2 115 kw., 2 180 kw., 2 45 kw. 2 202 kw., 2 520 kw. | Direct .. | Condensing.... | Bare strip & armd. con., 3 core jute ins. lead cov. and armd. | 105,000 8 c.p. | — | 35,000 .. | 5d. or 5½d. first hr., 2½d. after, 2½d. power | Brighton | Hookham, Ferranti, and Thomson | 2,210 kw. | Steam coal | £72,000 | £55,000 | — | Majority |
| Phillips, and | 2 9·5 units, 1 24 units | Belt .... | Non-condensing | Overhead ..... | 2,160 8 c.p. | 12 50 c.p., 76 20 c.p. | 210, and 1 20 c.p. for streets | 6d. and 5d. lighting, 3d. power | — | Hookham ..... | 68 kw. | Coal ..... | £3,500 | £950 | 5/2 | 216, 230 |
| ..... | 6 30 kw. ..... | Belt .... | Condensing.... | Steel armoured .. | — | 187 arcs .. | — | — | — | — | 180 kw. | Welsh coal | £20,000 | | — | — |
| lar, Parsons | 3 90 kw., 1 200 kw. | Direct coupled | Changing over to condensing | H.T fds.con., solid, twin cbs. L.T. fds. | 30 arcs .... | 104 arcs, 96 incand. | 5,000; 5,000 waiting | 5d. per unit, or reb. 7d. 1st hr. | Dir. on cur. con. & max. | Chamberlain-Hookham | 490 kw. | Coal ..... | £35,211 | £8,000 | — | 10,000 .. |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 150 h.p. each, 1 0 h.p. | Parker | 2 72 kw., 1 150 kw. | Direct coupled | Non-condensing | with bitumen Callender's triple con. feeders, cbls. lead cov. & armd. | 17 arcs 7,236 8 c.p. | 5 arcs, 220 16 c.p. incandscnt. | 6,000 | Ltg. 7d., 4d. & 2d., motors 4d. and 1½d. | Wright's max. demand | Ferranti, Chamberlain-Hookham, and Aron | 194 kw. |
| 00 h.p., 2 do. 250 h.p., h.p., 1 do. 38 h.p., 50 h.p. | Crompton | 3 60 kw., 1 154 kw., 1 90 kw., 2 222 kw., 1 23 kw. | Direct .. | Non-condensing | In culvrts., and i.r. cable in c.i. pipes | 44,892, 33 watt | 20 8 c.p. incandescnt. | 7,925 | 8d. first hour, 4d. after, discounts | Brighton | Ferranti | 1,045 kw. |
| ortex turbines, 16 to | Hall | 35 to 45 amps., 330 to 250 v. | Belts | — | Callender's, lead sheathed and steel armoured | 400 incand. | 32 32 c.p. | 500 | 6d. per unit | Meters & contract | Schattner | 23 kw. |
| 25 h.p. | Goolden | 2 75 kw. | Direct .. | — | Callender's armoured | 11,344 8 c.p. | — | 2,098 | 6d. lighting, 3d. power | No rebate | Kelvin and Ferranti | 150 kw |
| 65 b.h.p. each | 2 pole, 400 volts | 40 kw. | Belts | — | Con. fdrs. lead. sh , partly cond , partly arm'd laid direct | 12 arcs, 5,750 8 c.p. incandsnt. | 14 arcs, 1,250 8 c.p. incandsnt. | All | 5½d. | Uniform charge | Ferranti and Thomson | 200 kw. |
| 350 h.p., 1 (Willans) (Willans) 135 h.p., 60 h.p | 3 Brush, 1 Mather and Platt | 1 120 kw., 1 80 kw., 1 36 kw., 1 180 kw. | Direct .. | Condensing | Callender's bitumen cable | In Mar. 1899, 17,807 8 c.p. | To date, 29 arcs, 55 incandsnt. | From Mar. 25 to Dec 31, 3,210 | 4½d. lighting, 3d. power | 5 % disct. | Principally Hookham | 420 kw. |
| h.p., 1 horiz. 30 h.p. | Chamberlain and Hookham | 4 80 kw., 1 30 kw. | Ropes and belts | Condensing | Callender's, brick culverts and also armoured feeders | 8,448 8 c.p. | — | 1,700 | 7d. to 5d. | Rd.aft. 12 units pr. 16 c.p. pr. qtr. | Hookham | 304 kw. |
| 0 h.p., 1 do. 100 h.p. | Silvertown horse-shoe 2 pole inverted machines | 4 92 kw., 1 60 kw. | Direct .. | Non-condensing | B.I.W., laid direct in grnd. with steel protection plates | 14,000 8 c.p. | 105 arcs | 14,000, b'n running a year | 5d. unit ltg., 1½d. power | Meter .. | Ferranti and Aron | 428 kw. |
| engines, 60 b.h.p., 4 p., 1 (Willans) 350 | Fuller-Wenström, E.C.C., General Electric Co., and Mather & Platt | 4 85 kw., 4 52 kw., 1 230 kw. | Belts and dir. cpld. steam | Non-condensing | Siemens' conc. in Doulton con. arm. West Elec., Call. | 85 arcs, 18,000 8 c.p. | 12 arcs, 267 incandescent | 9,131 | 5d. 1st 1½hr., 2d. aft. ltg. 5d. 1st hr , 1d. aft. pr. | Brighton | Ferranti, Thomson, and Hookham | 578 kw. |
| 0 i.h.p., 2 (Willans) | Laurence, Scott & Co | 3 of 66 kw., 2 of 200 kw. | Direct coupled | Ejector condensers | Armrd. conc. and triple conc. laid in bitumen | About 11,000 8 c.p. | 30 arcs, 60 incand. | — | 6d. 1st hr's av. dmard. p. day p. qtr., 2½d. aft. | — | Ferranti and Schattner | 598 kw. |
| h.p. and 1,200 h.p. | Siemens and E.C.C. | 160 kw. and 600 k.w. | Direct .. | Condensing and non-condensing | Callender's solid .. | 117,773 16 c.p. | 142 arcs .. | 26,652 16 c.p. | 4d. lighting, 2d. and 1d. power | — | Hookham and Ferranti | 7,090 kw. |
| 75 h.p. | Shunt wound | 2 100 kw., 1 50 kw. | Direct .. | Ledward evaporative condrs. | Triple con. feeders, 3 core distribtrs. | 12,000 8 c.p. | 48 arcs, with incan. bkts. on 4 poles | Started Nov. 5, 1898 | 6d. per unit (Scale A) | 7d. 1st hr., 3½d. aft. (Scale B) | Bastian and Ferranti | — |
| am comp., 56 b.h.p. | Shunt-wound dynamo | 39 kw. | Leather belting | Non-condensing | Bare wire overhead | 1,000 8 c.p., 6 arcs | None yet .. | 200 | 4½d. per unit | Meter and per lamp | Chambrln.-Hookham and Bastian Electrolytic | 49 kw. |
| 2,500 h.p. | 12 bi-polar, 2 multi-polar .. | 12 250 kw., 2 1,500 kw. | Belts and direct | Condensing | Bare cop. con. cul., vul. rub. in p. vul. rub., vul bit., & ld. cov. paper, laid sol. | 2,095 arcs, 222,176 8 c.p. incandescent | 29 arcs | 46,636 .. | 5d. or £7 kw., inst. plus 1½d. unit, spcl. pwr. rts. 1½d. or 2½d. | Hopkinson | Ferranti, Thomson-Houston, Aron, Chamberlain-Hookham | 6,000 kw. |
| e 30 h.p. | Crompton | 26 kw. | Belt | Non-condensing | Overhead wire .. | — | 36 incndsnt. | 80 | 6d. per unit | — | Thomson and Hookham | — |
| 0 h.p. | 2 Wilson | — | Belt | Non-condensing | Overhead and i.r. cables in pipes | 8 arcs, 900 incandescent | — | — | — | By contract | — | 66 kw. |
| | — | 93 kw. | Direct .. | — | Lead cov. vul. cbs. in c.i. pipes, con. earthen. troughs | 5,900 8 c.p. | 4 arcs | 760 | 5d. lighting, 2d. power, 5% off | Discounts | Ferranti, Chamberlain and Hookham | 100 kw. |
| 50 h.p., 2 do. 350 h.p., p. on order | 4 Johnson and Phillips 4 pole slotted armatures, 1 6 pole on order | 1 88 kw., 2 165 kw., 1 400 kw. on order | Direct .. | Non-condensing | Lead cov. dist. laid solid, fdrs. lead cov. in conduits | Equivlnt. of 8,500 8 c.p. | 90 arcs, 180 32 c.p. incandescnt. | — | 6d. and 4d., 3d. after; also discnts. | Maximum demand | Thomson-Houston | 418 kw. |
| h.p., 1 (Willans) 80 iss) 40 h.p., 2 (Will-p. | Crompton and 1 E.C.C. | 2 64 kw., 1 68 kw., 1 25 kw., 1 44 kw., 2 120 kw. | Direct and ropes | Non-condensing | Bare strip | 19,763 8 c.p. | 2 arcs | 6,702 | 6½d. and 3½d. 5% dis., 3½d. & 1½d. motor pr. | Brighton | Hookham | 505 kw. |
| each 100 b.h.p. .. | Overtype shunt dynamos .. | 60 kw. | Belting | — | Paper ins., triple conc. and armd., laid direct in gnd. | 6,186 8 c.p. | Equivalent 88 8 c.p. | 2,301 | 6d. per unit 1st hour, 4d. after | Brighton | Chamberl'n-Hookham, Aron and Long-Schattner | 180 kw. |
| 00 i.h.p., 3 do. 185 200 i.h.p., 3 do. 300 | Norwich | 6 30 kw., 3 81 kw., 2 125 kw., 3 187 kw. | Direct .. | Separate Körting condenser to each engine | Bare copper in culverts | 243 arcs, 25,900 16 c.p. | — | 9,800 .. | 5d. | — | Scott, Hookham and Schattner | 1,234 kw. |
| h.p., 7 do. 134 h.p., p., 3 do. 700 h.p. | Siemens | — | Direct .. | — | Callender's | 86,000 equiv. 8 c.p. | 15 arcs | — | 4d. to 2d. ltg., 1d. power | Brighton | Ferranti and Hookham | 2,940 kw. |
| ertype | J. C. Howell | 1 200 amps., 1 300 amps., 5 70 amps. | Belt | Non-condensing | Overhead wires .. | 1,000 16 c.p. | 180 incand. | 100 | 6d. and 8d. | Contract chiefly | Ferranti | 850 amp. |
| 0 h.p., 2 do. 100 h.p., p., 4 do. 360 h.p. | Charlesworth Hall, and Siemens | 2 36 kw., 2 60 kw., 2 120 kw., 4 225 kw. | Direct .. | Condensing | Bare strip & rub. & pap. cabs. in iron pipes & bit. cabs. | 32,281 8 c.p. | 28 arcs | 5,900 | 4d. & 2d. priv. customers 2½d. street lgt. | Brighton 2 hours | Ferranti | 1,332 kw. |
| 1 (Belliss) | 2 Parker, 1 Siemens direct coupled to engine | 2 30 kw., 1 33 kw. | Ropes and direct driven | Non-condensing | Callender's armoured cables | 4,000 8 c.p. | — | 180 | 7d. | Meter .. | Hookham and Ferranti | 93 kw. |
| 0 i.h.p , 2 (Willans) (Willans) 25 i.h.p. | Crompton and Parker | 2 34 kw., 1 13 kw., 1 70 k.w. | Direct .. | Non-condensing | Copper strip, and Callender's armoured | 23 arcs and 5,202 8 c.p. | — | 508 | 6d. lighting, 3d. power | By meter | Ferranti and Hookham | 151 kw. |
| b.h.p., 1 (Belliss) 200 lliss) 330 b.h.p. | Westminster, Siemens, and E.C.C. | 9 66 kw., 2 225 kw., 2 16·5 kw. motor alternators | Direct .. | Non-condensing | Bare strip cable in pipes and arm'rd H.T. concentric | 40,102 8 c.p. | 42 arcs, 10 amps. | 9,252 | 7d. and 4d., less 15 % for cash | Brighton | Ferranti and Hookham | 1,044 kw. |
| 60 h.p., 2 200 h.p., | Latimer Clark, Muirhead & Co., Mordey | 3 67 kw., 2 45 kw., 2 130 kw., 230 v. | Direct .. | Non-condensing | Bare strip, and Henley, Silvert'wn. and Glover cable | 14,310 8 c.p. | — | 1,930 | 7d., after Apl. 6d. lighting, 4d. power | — | Ferranti | 540 kw. |
| 25 h.p., 1 (Shanks) Belliss and Morcom h.p. | 1 (Flather) multi-polar, 1 (Silvertown) shunt wound, Crompton | 1 200 amps., 1 230 amps. | Belt and direct | Non-condensing | B.I.W. paper insulation lead cov. in pipes | 600 8 c.p. | 14 25 c.p. .. | 100 | 6d. | — | Ferranti | — |
| 1 (Gilkes) turbine, s-Parker set 84 kw., v., 420 revs. ; 1 new r set 92 kw. erecting | Parker. 2 boosters 70 v., 70 amps., 2 machines 230 v., 100 amps., all on one shaft; 1 84 kw., 1 92 kw. erecting | Turbine runs at 28 revs., and is coupled by gearing & belting to balance set | — | Wright's heater condenser | Callender's 3 core distrbtrs., T.C.C. feeders | 148 consumers, 6,228 8 c.p. equiv. | None | 91 consumers, 4,059 | 7d., 4d. and 2d. | Rebate .. | Ferranti, Hookham, and Schattner | 166 kw. |
| | 1 Crompton, 2 Kapp, 1 Veale | 1 44 kw., 2 21 kw., 1 9 kw. | Belts and counter shafting | Non-condensing | Parallel | 8 arcs, 2,000 incan. | — | — | — | Rebate 6½d., 3½d. | Chamberlain and Hookham | 95 kw. |
| i.h.p., 2 (Belliss) 150 | Parker | 3 33 kw., 2 100 kw. | Direct .. | Non-condensing | Callender's armoured cables | 8,394 | 4 arcs, 24 fixing | 2,894 | 7d., 4d. and 2d. | Brighton | Thomson, Ferranti, and Chamb'lain-Hookham | 299 kw. |
| 80 h.p., 2 (Willans) (Belliss) 140 h.p., 2 00 h.p., 1 (Willans) | Crompton | 3 120 kw., 2 100 kw., 1 90 kw., 2 60 kw., 1 30 kw., 1 60 kw. motor | Direct .. | Non-condensing | Bare strip, diatrine con. for altern. mains | 18,000 8 c.p. | 62 arcs | 7,337 | 6d. lighting, 3d. power | Brighton | Ferranti, Hookham, Aron, and Shallenberger | 780 kw. |
| | E.C.C. | 3 66 kw. each | Rope .. | Jet condenser .. | Vulcanised rubber in Doulton conduits | 7,500 8 c.p. | 4 arcs | 500 | 7d. & 3d. ltg. 3d. power | Brighton | Hook'm, Ferranti, and Thomson-Houston | 198 kw. |
| 0 h.p., 2 (Willans) | McClure and Whitfield | 56 and 140 units | Direct .. | Non-condensing | Armoured | — | 32 arcs | 7,700 | 5d. | Direct .. | Ferranti, Reason, and Bastian | 450 kw. |
| | Brush multi-polar | 2 150 kw., 2 25 kw. | Direct coupled | Non-condensing | Con. & triple con., arm. bit. cbls laid in wood troughs | — | — | — | — | — | — | — |
| 0 h.p., 5 (Belliss) 200 ans) 50 h.p. | Holmes, Parker, Crompton, Sunderland Forge & Silvertown | 2 26 kw., 5 125 kw., 4 215 kw., 2 38 kw., motor | Direct .. | Non-con.; Wh'el'r surf. con. & cool. tower fixing | Bare strip, Silvertown and Callender's solid | 35,027 8 c.p. | 50 arcs | 11,000 .. | 5d. lighting, 2½d. power | Brighton | Ferranti and Thomson-Houston | 1,540 kw. |
| mpound 110 b.h.p. | Parker 2 pole | 84 kw. | Direct .. | Non-condensing | Callender's triple conc. fdrs. 3 core dis., steel arm'd. | — | 24 arcs, 100 incandsnt. | 3,800 | 7d. first hour, 4d. after | Wright's max. demand | Ferranti | 168 kw. |
| h.p. | Crompton | 35 kw. | Direct .. | Condensers (Ledward) | I .R. cables in earth. pipes and lead cov. B.I.W. Co. sol. sys. | Equivalent 9,024 8 c.p. | 452 incndsnt. 10 arcs | 2,550 | 5d. unit, £6 an. kw. max. dem. 2d. per unit | — | Hookham, Ferranti, and Aron | 210 kw. |
| h.p., 1 (Belliss) 300 | Parker | 2 115 amps., 1 410 amps. | Direct coupled | Non-condensing | Tri. con. feeders, 3 core dis. | 10,000 | — | 6,228 | 7d., 5d. and 2d. | Wright's | Ferranti | 293·5 |
| 200 i.h.p., 1 do. 100 160 i.h.p., 1 (Belliss) | Siemens | — | Direct .. | Non-condensing | Triple concen. armoured | 27 arcs, 7,527 8 c.p. | 290 16 c.p., 34 arcs | 7,000 .. | 6½d., motors 4d. per unit | 50 % reb. af. ern. 12s. 8 c.p. an. | Ferranti, Hookhm., Thomson-Hston., Aron, and Bastian | 625 kw., without cells |
| 30 h.p. | Sunderland Forge (engines and dynamos) | 2 20 kw., 2 100 kw. | Direct .. | Non-condensing | Net work, 3 wire .. | 5 arcs | 14 arcs, 181 posts 2 10 c.p. each (a) | 4,254, from May, '99 | 6d. and 2d. .. | Demand indicator | Thomson-Hstn., Bastian, Long-Schttnr. (prepay.) | 240 kw. |
| | E.C.C. | 80 kw., 150 and 200 kw. | Direct .. | Non-condensing | Callender's in stoneware casings | 129,000 8 c.p. | — | 16,000 .. | 6d. to 3d. lighting, 3d. power | Brighton | Hookham and Ferranti | 3,060 kw. |
| 910 h.p., 7 (Willans) Willans) 80 h.p. | Siemens and Crompton | 50 and 150 kw. | Direct .. | Condens. (Ledward evap., Edwards air p'mps) | Ld. cov. pap., rub. cables in iron pipes & bare strip in cul. | 183,462, inclu. Knightsbridge Wks. Equivalt. of 17,432 8 c.p. | 1 arc | 29,724 .. | 6d. at 100, 5d. at 200, 4d. power | Rebates | Aron, Ferranti and Hookham | 1,000 kw. |
| gines 250 h.p. each | 4 pole | 125 kw. each | Direct .. | Non-condensing | Bare copper and Callender's bitumen | — | — | 6,896 | 6d. to 3¾d. (b) | Sliding scale | Hookham | 600 kw. |
| | Crompton and Siemens | 120 and 200 kw. | Direct .. | Non-condensing | Cables and bare strip, in Doulton conduits | 35,500 8 c.p. | — | 1,308 8 c.p. | 8d. at 100, 6d. at 200, 4d. day load | By meter | Aron, Ferranti, and Hookham | 620 kw. |
| 0 h.p. | Siemens | — | Direct .. | Non-condensing | Callender's bitu.. Siemens, bare copr., and B.I.W. | 163,650 8 c.p. | 61 arcs | 21,897 .. | Ltg. 6d. to 4d., less 8 %, pwr. 3d. | 1st 4,000 6d., aft. 4d., less 8 % | Hookham, Ferranti, Aron, and T. H. | 3,880 kw. |
| 200 h.p., 1 (Willans) (Willans) 80 h.p., 12 0 h.p. | Mather and Platt, and Siemens | 5 100 kw., 1 75 kw., 2 40 kw., 12 250 kw. | Direct .. | Non-condensing | Callender's in casing, armoured and paper cables | 182,689 8 c.p. | — | 48,453 .. | 6d. lighting, 4d. power | Sliding scale | Aron, Ferranti, and Hookham | 3,555 kw. |
| 3,080 i.h.p., 3 (Belliss) (Peache) 250 i.h.p. | Kapp, Latimer, Siemens, and Crompton | 50 to 500 kw. | Direct .. | Condensing | Bare strip and armoured cable | 110,462 8 c.p. | 230 arcs. | 20,276 8 c.p. | Indictr. systm., 6d. 1st 1½ hs., 3d. after | Brighton, optional | Aron, Hookham, Ferranti, and Thomson | 2,590 kw. |
| o 361 i.h.p. | E.C.C., Crompton, Siemens, and Goolden | Up to 225 kw. | Direct .. | — | Armoured, strip and casing | — | 12 arcs | 427,000 | 6d. lighting, 3d. pwr., with rebates | Rebates and discounts | Aron, Ferranti | 6,100 kw. |
| 200 i.h.p., 1 do. | Mather and Platt 4 pole | 2 60 kw. in tandem on small engine, 1 275 kw. on large eng. | Direct .. | Non-condensing | B.I.W. solid, 3 single mains | — | 50 arcs | — | 8d. 1st hr., 1d after | Wright's | Reason | 395 kw. |
| bns. 110 kw., 1 (Allen) 00 kw., 1 (Bumstead-nclosed 110 kw. | Parsons 2 pole, Allen 2 pole, E. A. & G. multi-polar | 3 110 kw. each, 1 100 kw. | Direct and belts | Surface cndnsg. (Thames water us'd for cooling) | Cllndr.'s ld, cov.ar., 3 core dis. tpl. fdrs., vul. bit dis. c.i. ps. | 10,023 | — | 5,203 | 6d. light, 3d. power | 5 % in 14 days | Ferranti and Aron | 430 kw. |

# HIGH PRESSURE CONT

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ) 75 kw. | 4 pole Universal | 75 kw. | Direct .. | Non-condensing | B.I.W. conc. | Dec. 31, '99, 9,237 | 22 10 amp. arcs, 44 16 c.p. incan. | 9,237 | 6d. 2 hs., 3d. aft. ltg., 6d. 1 hr., 1½d. aft. pwr. | Brighton | Ferranti and Cham.-Hookham | 225 kw. |
| ine 20 h.p., nom. 42 b. | Thomson-Houston series | 18 arc lighter | Belt | — | British Insulated Wire Co.'s, lead covered | — | 17 arc, 3 32 c.p. incandescent | — | — | — | — | 18 arcs |
| 90 h.p., 2 do. 200 h.p., p., 2 do. 100 h.p., 2 do. (Allen) 800 h.p. | Siemens, Holmes, 2 Parker, 220 v., 4 do., 2,250 v. | 2 44 kw., 2 115 kw., 2 180 kw., 2 45 kw. 2 202 kw., 2 520 kw. | Direct .. | Condensing | Bare strip & armd. con., 3 core jute ins. l. ad cov. and armd. | 105,000 8 c.p. | — | 35,000 .. | 5d. or 5½d. first hr., 2½d. after, 2½d. power | Brighton | Hookham, Ferranti, and Thomson | 2,210 kw. |
| h.p. (Davey-Paxman) 36 i h.p. | Johnson and Phillips, and Taunton | 2 9·5 units, 1 24 units | Belt | Non-condensing | Overhead | 2,160 8 c.p. | 12 50 c.p., 76 20 c.p. | 210, and 1 20 c.p. for streets | 6d. and 5d. lighting, 3d. power | — | Hookham | 68 kw. |
| cond., 150 h.p. | Siemens | 6 30 kw. | Belt | Condensing | Steel armoured .. | — | 187 arcs .. | — | — | — | — | 180 kw. |
| Parker) 125 i.h.p., 2 15 ar.) turbine 300 h.p. | Parker bi-polar, Parsons bi-polar | 3 90 kw., 1 200 kw. | Direct coupled | Changing over to condensing | H.T fds.con., solid, twin cbs., L.T. fds. & dis., Call.'s conc. | 30 arcs | 104 arcs, 96 incand. | 5,000; 5,000 waiting connect. | 5d. per unit, or reb. 7d. 1st hr. 3d. after 7d. | Dir. on cur. con. & max. demand | Chamberlain-Hookham | 490 kw. |
| 50 h.p., 1 do. 200 h.p., n.p. | E.C.C., 1,000 v. | 3 90 kw., 1 100 kw., 1 260 kw. | Ropes and belt | Condensing | H.T. i.r. cables in iron pipes L.T. Callender's | 30 arcs and 25,500 8 c.p. | 32 arcs and 48 16 c.p. | 3,800 | — | — | Hookham and Ferranti | 630 kw. |
| — | Brush, driven by power supplied from Kodak Vale Col'ry | 14 kw. | Belt | — | Overhead | — | 23 arcs | — | — | — | — | — |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ti, Cham-<br>n-Hookham,<br>ron | 194 kw. | Hard steam coal | £32,415 | 10,000 | 5/6 | | | | £2,050 | | | |
| ti ..... | 1,045 kw. | Welsh coal | £42,690§ | £42,641 | 5/5 | 25,327 ..... | 220 v. .... | 23 = 36 kw. .. | §Exclusive of mtrs. and demand meters, £6,716 | C. Bottomley Smith | Hove .....(39) | |
| ner ..... | 23 kw. | Water power | £3,500 (about) | | — | 70 200 v. ..... | 100 v. and 200 v. | — | Mains sup. through battery of 116 27 plate D.P. cells | H. W. Brotherton | Ingleton .....(40) | |
| and Ferranti | 150 kw | Screened nuts | £26,160 | £9,660 | — | None ..... | 100 v. .... | 1 = 5 h.p. for driving mechanical stoker | — | A. D. Brigham | Kelvinside ....(41) | |
| ti and Thomson | 200 kw. | Anthracite pea nuts | £29,500 | — | — | All..... | 200 v. .... | 2 = 1½ h.p..... | — | J. Pilling ..... | King's Lynn ....(42) | |
| pally Hookham | 420 kw. | Burgie .... | £28,662 | | 5/1½ | None ..... | 100 v. and 200 v. | About 35 = 150 h.p. | — | W. A. Fraser .. | Lancaster .....(43) | |
| am ..... | 304 kw. | Coal ..... | — | — | 6/2 | — | 113 v. .... | — | — | F. W. E. Jones | Leamington ....(44) | |
| ti and Aron | 428 kw. | Washed pearls | £30,000 (in mains) | £7,900 | — | — | 230 v. and 460 v. | 15 = 151 h.p... | — | W. A. Bryson, consultg. & res. engineer | Leith .....(45) | |
| ti, Thomson, Hookham | 578 kw. | Welsh anthracite & hard steam | £59,478 | £20,000, service £4,200 | 5/6 | None ..... | 150 volts .. | 8 = 7 h.p. .... | Steam plant, temp. bldgs. in progress to take stm. plant | F. Harman Lewis | Leyton .....(46) | |
| ti and Schattner | 598 kw. | Coal ..... | £32,000 | £9,000 approx. | — | — | 230 v. .... | 10 h.p. ..... | — | C. S. V. Brown | Lincoln .....(47) | |
| am and Ferranti | 7,090 kw. | Slack .... | — | — | — | — | 230 v. .... | 219 = 740 h.p. | — | A. Bromley Holmes | Liverpool .....(48) | |
| n and Ferranti | — | Coke..... | £25,000 | — | — | — | 220 v. .... | — | — | Harold Morton | Llandudno ....(49) | |
| orln.-Hook-and Bastian rolytic | 49 kw. | Small coal, ref. collected from streets | £2,000 | | Cannot yet be stated | All ..... | 220 v. .... | ½ h.p., ¼ h.p. .. | — | W. Jas. Price | Maerdy (Glamorganshire) (50) | |
| ti, Thomson-ton, Aron, berlain-Hookham | 6,000 kw. | Washed slack | £263,620, excluding mains to Mr. 31,'99 | £230,096 | 3/5 | A considerable number | 100 v., 200 v., 300 v. or 400 v. | 464 = 1,704 h.p. | Plant on order 4 1,800 kw., 2 750 kw., all direct driven | C. H. Wordingham | Manchester ....(51) | |
| on and Hookham | — | Welsh steam coal | — | — | — | — | — | — | — | J. G. Hill..... | Mevagissey ....(52) | |
| — | 66 kw. | Coal ..... | — | — | — | — | 100 v. .... | — | — | W. Crookell .. | Middleton .....(53) | |
| ti, Cham-n and ham | 100 kw. | Coal and coke | £4,500 | £5,600 | 5/6 | — | 110 v., about 2,000 | — | — | Alicander Allan | Nelson.....(54) | |
| on-Houston | 418 kw. | Pea size coking coal | £50,000 | — | — | — | 220 v. .... | Equivlnt. of 422 8 c.p. | Mechanical stoker | J. R. Blaikie .. | Newington ....(55) | |
| am ..... | 505 kw. | Coal and slack | £31,000 | | 6/10 | — | 210 v. .... | 50 = 5 h.p. .... | — | W E. J Heenan | Northampton ..(56) | |
| erl'n-Hook-Aron and Schattner | 180 kw. | Mond producer gas | — | — | — | — | 220 v. .... | 9 = 61 h.p..... | — | A. W. Sclater.. | Northwich ....(57) | |
| Hookham chattner | 1,284 kw. | Coal ..... | £45,500 | £44,200 | 7/9 | Outlying districts | 110 v. and 220 v. | 140 h.p. ..... | — | F. M. Long.... | Norwich .....(58) | |
| ti and Hookham | 2,940 kw. | Coal ..... | £127,393 (31 Mar. 1899) | | 4/10 | — | 100 v. and 200 v. | 130 = 470 h.p. | — | H. Talbot .... | Nottingham ....(59) | |
| ti ..... | 850 amp. | Small coal | £5,565 | | 8/9 and 12/6 | None ..... | 100 v. to 115 v. | 70 h.p. ..... | — | — | Ogmore Valley (60) | |
| i ..... | 1,332 kw. | Slack coal | Capital tu re £67,600 | expendi- | 5/3 | All..... | 210 v. and 105 v. | — | — | S. Wilmott Newington | Oldham .....(61) | |
| am and Ferranti | 93 kw. | Coal ..... | £5,867 | | 3/4 | All..... | 220 v. .... | 1 = 3 h.p. .... | — | E. Bremner Smith | Oswestry .....(62) | |
| i and Hookham | 151 kw. | Small coal washed | £8,741 | £1,051 | 5/0½ | None ..... | — | — | — | G. A. Maquay.. | Pontypool .....(63) | |
| i and Hook- | 1,044 kw. | Small slack | — | — | — | — | — | — | Extensions of 1,000 kw. in hand | J. H. Tonge .. | Preston* .....(64) | |
| i ..... | 540 kw. | Welsh coal | £18,663 | £14,845 | 9/- | None ..... | 110 v. .... | — | — | M. C. Flemyng | Richmond (Surrey) (65) | |
| i ..... | — | Welsh coal | — | — | — | — | 100 v. .... | 1 = 1 h.p. .... | — | A. Jupp ..... | Rottingdean....(66) | |
| , Hookham, chattner | 166 kw. | Farringdon small coal, 10/3 per ton delivered | £27,203 | £5,506 | 6/3 | All..... | 210 v. .... | 6 = 5¾ h.p..... | — | L. A. Hards .. | Salisbury .....(67) | |
| erlain and Hookham | 95 kw. | Coal ..... | £6,000 | — | — | — | 100 v. .... | 14 = 14½ h.p... | — | J. M. Coon .... | St. Austell.....(68) | |
| n, Ferranti, hamb'lain-am | 299 kw. | Coal ..... | — | — | 7/3 | All..... | 210 v. .... | 27 h.p. ..... | Approx. cost of extensions by Corporation £30,000 | C. M. Johnston | Shrewsbury ....(69) | |
| i, Hook-Aron, and nberger | 780 kw. | Small coal | £55,000 | | 8/3 | None ..... | 100 v. and 200 v. | 35 = 160 h.p. .. | — | F. H. Chaplin | Southampton*..(70) | |
| , Ferranti, Thomson-on | 198 kw. | Coke breeze coke, and rough slk. | £20,000 | £4,000 | 3/11 | Very few ..... | 105 v. and 210 v. | — | — | J. Ferguson Bell | Stafford .....(71) | |
| i, Reason, astian | 450 kw. | Coke breeze | — | — | — | — | 230 v. .... | 1 = 80 h.p., 1 = 4 h.p. | — | S. Meunier, A. J. H. Carter, (electrical man.) | Stockport .....(72) | |
| — | — | — | — | — | — | — | 230 v. .... | — | Station not ready for supply | J. J. Smith, Wm. Ford, genl. mnger. | Stockton .....(73) | |
| i and n-Houston | 1,540 kw. | Small coal Durham | £41,000 | £31,000 | 5/1 | About half total wired | 110 v. and 220 v. | 420 h.p. ..... | — | John F. C. Snell | Sunderland ....(74) | |
| ..... | 168 kw. | Steam coal | — | — | — | — | 210 v. .... | — | — | A. E. Mayes.... | Ventnor .....(75) | |
| n, Ferranti, on | 210 kw. | Washed nuts | £20,275 | £9,261 | 8/1 | About 50 ..... | 105 v. and 100 v. | 4 = 17 h.p..... | — | J. Gray Scott .. | Whitehaven....(76) | |
| ..... | 293·5 | Welsh sm'keless steam coal | £20,335 | £6,280 | 3/6 | 2,705 lamps, 89·2 units | 210 v. .... | 2 = 6 h.p. .... | — | H. N. Warburton | Winchester ....(77) | |
| , Hookhm., on-Hston., nd Bastian | 625 kw., without cells | Anthracite peas, Powell Duffryn | £23,000 | £19,000 | — | 1,580 8 c.p. .... | 110 v. and 220 v. | 32·5 h.p. ..... | Wright's max. demand indicator now being introduced | A. E. Farrow .. | Windsor.....(78) | |
| | | | | | | | | | | | **LONDON.** | |
| n-Hstn., n, Long-r.(prepay.) | 240 kw. | Welsh coal | Not finished | | Not yet run full year | — | 230 v. .... | 17 h.p. ..... | (a) 376 posts, 2 10 c.p. each when finished | S. E. Britton .. | Barking.....(79) | |
| n and Ferranti | 3,060 kw. | Welsh coal | — | — | 5/8 | All new connections | 200 v. .... | — | — | Percy Still .... | Chelsea .....(80) | |
| rranti and am | 1,000 kw. | Welsh coal | £263,481 both works and whole system | | 6/- | 120,727..... | 200 v. .... | 20 = 75 h.p. .. | — | H. W. Miller .. | Kensington Court Works (81) | |
| n ..... | 600 kw. | Welsh steam coal | — | — | 12/11 | 1,027 8 c.p. .... | 100 v. and 200 v. | — | (b) Price inclu. free wiring, mainten., clng. & renewals | Eustace Ridley | London .....(82) | |
| erranti, Hookham | 620 kw. | Welsh coal | £31,107 | £52,637 | 6/5 | About 80% of connections | 100 v. and 200 v. | 21 h.p. ..... | — | Geo. Schultz .. | Notting Hill ....(83) | |
| am, Fer-Aron, and | 3,880 kw. | Coal ..... | — | — | 9/2 | — | 107 v. .... | — | — | Sydney T. Dobson | St. James's Parish (84) | |
| erranti, okham | 3,555 kw. | Welsh coal | — | — | — | Insignificant .. | 100 v. and 200 v. | — | Work under the City of London Order, 1899, in hand | W. H. Patchell | St. Martin's in the Fields, Strand District. S. Holborn and St. Giles ..(85) | |
| Hookham, i, and on | 2,590 kw. | Coal ..... | Approximately £112,419 £129,574 inclu. lanc | | 7/6 | — | 110 v. and 220 v. | 111 = 400½ h.p. | — | Sydney W. Baynes | St. Pancras ....(86) | |
| rranti .. | 6,100 kw. | Welsh coal | — | — | (c) .... | All new consumers | — | — | (c) Figures not yet made out | Dr. A. B. W. Kennedy | Westminster and St. George's (87) | |
| ..... | 395 kw. | Welsh .... | — | — | — | — | 240 v. .... | — | Started running Dec., 16th, 1899 | A. Wright, conslt. W. C. P. Tapper, resident | Whitechapel ..(88) | |
| and Aron | 430 kw. | Welsh coal | — | — | 6/11 | — | 210 v. .... | 3 = 7 h.p. .... | Systm. chngd. Mar. '99, H.T. to L.T. d.c. supply uninterruptd | A. J. Fippard. Edmundsons, consultg. engrs | Woolwich‡ ....(89) | |

# ONTINUOUS.

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| and Hookham | 225 kw. | Coal ..... | £29,000 (approx.) | — | — | 9,237..... | 220 v. .... | 10 = 46·5 e.h.p. | Extension in progress | H. R. Burnett.. | **PROVINCIAL.** Barrow-in-Furness (1) | |
| - | 18 arcs | Gas ..... | — | — | — | — | — | — | — | A. Sharp ..... | Bridlington.....(2) | |
| , i, and on | 2,210 kw. | Steam coal | £72,000 | £55,000 | — | Majority ..... | 110 v. and 220 v. | 36 = 135 h.p. approximately | — | A. S. Barnard.. | Hull .....(3) | |
| ..... | 68 kw. | Coal ..... | £3,500 | £950 | 5/2 | 216, 230 v. .... | 115 v. and 230 v. | 2 = 6½ h.p..... | — | G. J. T. Parfitt.. | Keynsham .....(4) | |
| - | 180 kw. | Welsh coal | £20,000 | | — | — | — | — | — | R. V. Macrory.. | Londonderry ....(5) | |
| lain-Hookham | 490 kw. | Coal ..... | £35,211 | £8,000 | — | 10,000 ..... | 220 v. .... | 8 = 26 h.p..... | — | C. F. Parkinson | Morecambe.....(6) | |
| n and Ferranti | 630 kw. | Welsh coal | £67,000 | £30,000 | 8/- | — | 100 v. .... | 25 h.p. ....., | — | Percy J. Rea .. | Oxford .....(7) | |
| - | — | — | — | — | — | — | — | — | — | Wm. H. Barwell | Treeton.....(8) | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| (59) Nottingham | | | tub. Dryback | 4 do. 360 h.p., 3 do. 700 h.p. | | |
| (60) Ogmore Valley | Ogmore Valley Elec. Lgt. & Power Co. | 2 wire | Loco. type tubular | 2 35 h.p. undertype | J. C. Howell | 1 a |
| (61) Oldham | Corporation | 2 and 3 wire | 8 Lanc. | 2 (Willans) 60 h.p., 2 do. 100 h.p., 2 do. 200 h.p., 4 do. 360 h.p. | Charlesworth Hall, and Siemens | 2 2 |
| (62) Oswestry | Oswestry Elec. Lgt. and Power Co. | 2 wire at 220 v. | 2, 1 Babcock and Wilcox | 2 (Marshall), 1 (Belliss) | 2 Parker, 1 Siemens direct coupled to engine | 2 9 |
| (63) Pontypool | Pontypool Elec. Lgt. and Power Co. | 2 wire | 3 Marshall loco. type | 1 (Willans) 90 i.h.p, 2 (Willans) 60 i.h.p., 1 (Willans) 25 i.h.p. | Crompton and Parker | 2 3 76 |
| (64) Preston* | National Elec. Supply Co., Ltd. | 3 wire con. at 220 v., H.T. alternating | 6 Lanc. multitubular | 7 (Belliss) 100 b.h.p., 1 (Belliss) 200 b.h.p., 2 (Belliss) 330 b.h.p. | Westminster, Siemens, and E.C.C. | 9 6 2 al |
| (65) Richmond (Surrey) | Richmond Elec. Lgt. and Power Co. Ltd. | 3 wire | 3 Penman multitub., 2 Pax. econ. | 3 100 h.p., 2 60 h.p., 2 200 h.p., Universal | Latimer Clark, Muirhead & Co., Mordey | 3 6 18 |
| (66) Rottingdean | New Rottingdean Electricity Co. | 2 wire at 100 volts | 1 water tube, 1 Davey-Paxman | 1 (Browett) 25 h.p., 1 (Shanks) 8 h.p., 1 (Belliss and Morcom enclosed) 38 h.p. | 1 (Flather) multi-polar, 1 (Silvertown) shunt wound, Crompton | 1 2 ar |
| (67) Salisbury | Salisbury Elec. Light and Supply Co. | 3 wire | 2 Babcock | Water power, 1 (Gilkes) turbine, 60 h.p., Belliss-Parker set 84 kw., 180 amp., 460 v., 420 revs.; 1 new Belliss-Parker set 92 kw. erecting | Parker. 2 boosters 70 v., 70 amps., 2 machines 230 v., 100 amps., all on one shaft; 1 84 kw., 1 92 kw. erecting | Tur re by to |
| (68) St. Austell | Veale & Co... | 2 wire | Loco. type | 3 compound | 1 Crompton, 2 Kapp, 1 Veale | 1 4 1 |
| (69) Shrewsbury | Corporation | 3 wire at 420 between outers | 4 water tube, 2 Lanc. | 3 (Belliss) 50 i.h.p., 2 (Belliss) 150 i.h.p. | Parker | 3 3 |
| (70) Southampton* | Corporation | 3 wire, 100 and 200 v., and alterg. trans. 2,000 to 200 | 1 Lanc., 6 Babcock | 3 (Willans) 180 h.p., 2 (Willans) 150 h.p., 1 (Belliss) 140 h.p., 2 (Willans) 100 h.p., 1 (Willans) 60 h.p. | Crompton | 3 12 1 9 1 8 mo |
| (71) Stafford | Corporation | 3 wire | 3 Lanc. | 3 (Marshall) | E.C.C. | 3 66 |
| (72) Stockport | Corporation | 3 wire | Lancs. | 3 (Willans) 90 h.p., 2 (Willans) 240 h.p. | McClure and Whitfield | 56 a |
| (73) Stockton | Council | 3 wire | 3 Galloway | 3 Universal | Brush multi-polar | 2 15 |
| (74) Sunderland | Corporation | 3 wire, 110 v. 220 v. | 6 Lanc. 2 water tube, 2 Galloway | 4 (Belliss) 400 h.p., 5 (Belliss) 200 h.p., 2 (Willans) 50 h.p. | Holmes, Parker, Crompton, Sunderland Forge & Silvertown | 2 26 4 2 mo |
| (75) Ventnor | Ventnor Elec. Light and Power Co. | 3 wire | Babcock and Wilcox | 2 (Belliss) compound 110 b.h.p. each | Parker 2 pole | 84 k |
| (76) Whitehaven | Corporation | 3 wire | Lanc. | 6 (Willans) 60 h.p. | Crompton | 35 k |
| (77) Winchester | Elec. Ltg. Co. | 3 wire | 3 Babcock | 2 (Belliss) 80 h.p., 1 (Belliss) 300 h.p. | Parker | 2 11 am |
| (78) Windsor | Windsor Elec. Instlln. Co., Ltd. | 3 wire | 2 Lanc., 2 Dy.-Pxmn. economic | 2 (Peache) 200 i.h.p., 1 do. 100 i.h.p., 1 do. 160 i.h.p.. 1 (Belliss) 400 i.h.p. | Siemens | |
| **LONDON.** | | | | | | |
| (79) Barking | Urban District Council | 3 wire | Babcock and Wilcox | 1 60 h p., 2 130 h.p. | Sunderland Forge (engines and dynamos) | 2 20 |
| (80) Chelsea | Chelsea Electricity Supply Co. | 3 wire | Water tube | Willans | E.C.C. | 80 kw kw. |
| (81) Kensington Court Works | Kensington & Knightsbrdg. Elec. Ltg. Co. | 3 wire | 6 water tube B. and W. 1,500 h.p. | 9 (Willans) 1,910 h.p., 7 (Willans) 250 h.p., 2 (Willans) 80 h.p. | Siemens and Crompton | 50 ar |
| (82) London | Smithfield Markets Elec Supply Co. | 3 wire | 4 economic | 4 Windsor engines 250 h.p. each | 4 pole | 125 k |
| (83) Notting Hill | Notting Hill Elec. Ltg. Co. | 3 wire | Water tube | Willans | Crompton and Siemens | 120 a |
| (84) St. James's Parish | St. James's and Pall Mall Elec. Lt. Co. | 3 wire | Economic, Loco., and water tube | Willans 6,000 h.p. | Siemens | |
| (85) St. Martin's in the Fields, Strand District, South Holborn and St. Giles | Charing × & Strand Elec. Supply Co. | 3 wire at 100 and 200 volts | 17 watr. t'be. 2 marine | 5 (Willans) 200 h.p., 1 (Willans) 130 h.p., 2 (Willans) 80 h.p., 12 (Belliss) 500 h.p. | Mather and Platt, and Siemens | 5 100 2 40 |
| (86) St. Pancras | Vestry | 3 wire, 110 and 220 v., 3 wire, 440 v. | Water tube Lanc. and 3-flue mar. | 17 (Willans), 3,080 i.h.p., 3 (Belliss) 660 i.h.p., 1 (Peache) 250 i.h.p. | Kapp, Latimer, Siemens, and Crompton | 50 to |
| (87) Westminster and St. George's | Westminster Elec. Supply Corpn., Ltd. | 3 wire | Paxman and Babcock | Willans, up to 361 i.h.p. | E.C.C., Crompton, Siemens, and Goolden | Up to |
| (88) Whitechapel | District Board of Works | 3 wire at 240 v. and 480 v. | 2 Babcock, Destrctr. blr. as reserve | 1 (Willans) 200 i.h.p., 1 do. 450 i.h.p. | Mather and Platt 4 pole | 2 60 on 275 |
| (89) Woolwich† | Woolwich District Elec. Light Co. | 4 feeders to net work of distributors | 4 loco., 1 Dy. Pax. econo. bng. put dn. | 2 (Parsons) trbns. 110 kw., 1 (Allen) enclosed 100 kw., 1 (Bumstead-Chandler) enclosed 110 kw. | Parsons 2 pole, Allen 2 pole, E. A. & G. multi-polar | 3 110 100 |
| **PROVINCIAL.** | | | | | | |
| (1) Barrow-in-Furness | Corporation | 1,100 v. feeders 220 v. distrb. | 3 Babcock-Wilcox | 3 (Universal) 75 kw. | 4 pole Universal | 75 kw |
| (2) Bridlington | Town Council | Series | — | Otto gas engine 20 h.p., nom. 42 b. | Thomson-Houston series | 18 arc |
| (3) Hull | Corporation | H.P. con. with trans. & aux. L.T. plnt. | 4 mar. Dry-bk., 6 Lancs., 1 water tube | 2 (Willans) 80 h.p., 2 do. 200 h.p., 2 do. 300 h.p., 2 do. 100 h.p., 2 do. 360 h.p., 2 (Allen) 800 h.p. | Siemens, Holmes, 2 Parker, 220 v., 4 do., 2,250 v. | 2 44 2 18 2 20 |
| (4) Keynsham | Keynsham Elec. Lgt. & Pwr. Co., Ltd. | Series for streets, parallel | 2 48 i.h.p. Economic | 2 12 nom. h.p. (Davey-Paxman) indicating 36 i h.p. | Johnson and Phillips, and Taunton | 2 9·5 |
| (5) Londonderry | Corporation | Series | Penmans' Lanc. | 3 compound cond., 150 h.p. | Siemens | 6 30 k |
| (6) Morecambe | Urban District Council | 1,400 v. | Babcock-Wilcox and Lanc. | 3 (Peache-Parker) 125 i.h.p., 2 15 i.h.p., 1 (Par.) turbine 300 h.p. | Parker bi-polar, Parsons bi-polar | 3 90 k |
| (7) Oxford | Oxford Elec. Light Co. | Sub-station, motor trans. | 5 Loco. | 3 vertical 150 h.p., 1 do. 200 h.p., 1 do. 600 h.p. | E.C.C., 1,000 v. | 3 90 k 1 26 |
| (8) Treeton | Parish Council | Series | — | — | Brush, driven by power supplied from Rother Vale Col'ry | 14 kw |
| (9) Walsall | Corporation | Sub-station motor transformers | 2 Lanc., 1 water tube | 3 vertical 125 i.h.p., 1 vertical 300 i.h.p. | Parker | 3 80 k |
| (10) Wolverhampton | Corporation | Sub-stn. mot. trans., and 3 wire 440 v. | Lanc. | 3 250 h.p., 1 120 h.p., 1 200 h.p., 2 350 h.p. | E.C.C. and Parker | 4 140 220 |
| **LONDON.** | | | | | | |
| (11) Shoreditch | Vestry | Sub-station motor trans. | Dust destrs. wtr. t'be bls., & semi-mar. | 3 (Willans) 300 i.h.p., 3 do. 150 i.h.p., 3 (Belliss) 500 i.h.p. | E.C.C. | 3 165 3 25 |
| (12) Sydenham | Crystal Pal. Dist. Elec. Sup. Co., Ld. | Sub-station motor trans. and batteries | 5 Loco., 1 Hornsby water tube | 4 Horiz. compound 40 h.p. nom., 1 (Willans) 80 i.h.p., and 1 (Belliss) 280 i.h.p. | E.C.C. | 4 90 1 20 |

* Employing both Alternating and Continuous Current.
† No Return to hand.
‡ Combined High and Low Pressure.


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Bartholomew Works,

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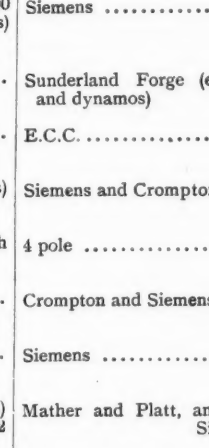


16 c.p. Standard Lamp. *Half size.*

DYNA MO RESIS

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| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ...ens | — | Direct | — | | | 8 c.p. | | | 1d. power | | Hookham | kw. | |
| . Howell | 1 200 amps., 1 300 amps., 5 70 amps. | Belt | Non-condensing | Overhead wires | 1,000 16 c.p. | 180 incand. | 100 | 6d. and 8d. | Contract chiefly | Ferranti | 850 amp. | Small |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ..... | 1 200 amps., 1 800 amps., 5 70 amps. | Belt .... | Non-condensing | Overhead wires .. | 1,000 16 c.p. | 180 incand. | 100 .... | 6d. and 8d. | Contract chiefly | Ferranti ..... | 850 amp. | Small coal | £25,565 | | 8/9 and 12/6 | None |
| Hall, and | 2 36 kw., 2 60 kw., 2 120 kw., 4 225 kw. | Direct .. | Condensing.... | Bare strip & rub. & pap. cabs. in iron pipes & bit. cabs. | 32,281 8 c.p. | 28 arcs .... | 5,900.... | 4d. & 2d. priv. customers 2½d. street lgt. | Brighton 2 hours | Ferranti ..... | 1,332 kw. | Slack coal | Capital £67,600 | expenditure | 5/3 | All... |
| Siemens direct engine | 2 30 kw., 1 33 kw. .. | Ropes and direct driven | Non-condensing | Callender's armoured cables | 4,000 8 c.p. | — | 180 .... | 7d. | Meter .. | Hookham and Ferranti | 93 kw. | Coal ..... | £5,867 | | 3/4 | All... |
| d Parker ..... | 2 34 kw., 1 13 kw., 1 70 k.w. | Direct .. | Non-condensing | Copper strip, and Callender's armoured | 23 arcs and 5,202 8 c.p. | — | 508 .... | 6d. lighting, 3d. power | By meter | Ferranti and Hookham | 151 kw. | Small coal washed | £8,741 | £1,051 | 5/0½ | None |
| Siemens, and | 9 66 kw., 2 225 kw., 2 16·5 kw. motor alternators | Direct .. | Non-condensing | Bare strip cable in pipes and arm'rd H.T. concentric | 40,102 8 c.p. | 42 arcs, 10 amps. | 9,252.... | 7d. and 4d., less 15 % for cash | Brighton | Ferranti and Hookham | 1,044 kw. | Small slack | — | — | – | |
| rk, Muirhead & | 3 67 kw., 2 45 kw., 2 130 kw., 230 v. | Direct .. | Non-condensing | Bare strip, and Henley, Silvert'wn. and Glover cable | 14,310 8 c.p. | — | 1,930.... | 7d., after Apl. 6d. lighting, 4d. power | — | Ferranti ..... | 540 kw. | Welsh coal | £18,663 | £14,845 | 9/- | None |
| multi-polar, 1 shunt wound, | 1 200 amps., 1 230 amps. | Belt and direct | Non-condensing | B.I.W. paper insulation lead cov. in pipes | 600 8 c.p. | 14 25 c.p. .. | 100 .... | 6d. | — | Ferranti ..... | — | Welsh coal | — | — | — | |
| oosters 70 v., 70 achines 230 v., ll on one shaft; 92 kw. erecting 2 Kapp, 1 Veale | Turbine runs at 28 revs., and is coupled by gearing & belting to balance set | — | Wright's heater condenser | Callender's 3 core distrbtrs., T.C.C. feeders | 148 consumers, 6,228 8 c.p. equiv. | None .... | 91 consumers, 4,059 | 7d., 4d. and 2d. | Rebate .. | Ferranti, Hookham, and Schattner | 166 kw. | Farringdon small coal, 10/3 per ton delivered | £27,203 | £5,506 | 6/3 | All... |
| | 1 44 kw., 2 21 kw., 1 9 kw. | Belts and counter shafting | Non-condensing | Parallel ..... | 8 arcs, 2,000 incan. | — | — | — | Rebate 6½d., 3½d. | Chamberlain and Hookham | 95 kw. | Coal ..... | £6,000 | — | — | |
| ..... | 3 33 kw., 2 100 kw. | Direct .. | Non-condensing | Callender's armoured cables | 8,394 .... | 4 arcs, 24 fixing | 2,894.... | 7d., 4d. and 2d. | Brighton | Thomson, Ferranti, and Chamb'lain-Hookham | 299 kw. | Coal ..... | — | — | 7/3 | All... |
| ..... | 3 120 kw., 2 100 kw., 1 90 kw., 2 60 kw., 1 30 kw., 1 60 kw. motor | Direct .. | Non-condensing | Bare strip, diatrine con. for altern. mains | 18,000 8 c.p. | 62 arcs .... | 7,337.... | 6d. lighting, 3d. power | Brighton | Ferranti, Hookham, Aron, and Shallenberger | 780 kw. | Small coal | £55,000 | | 8/3 | None |
| ..... | 3 66 kw. each ..... | Rope .. | Jet condenser .. | Vulcanised rubber in Doulton conduits | 7,500 8 c.p. | 4 arcs .... | 500 .... | 7d. & 3d. ltg. 3d. power | Brighton | Hook'm, Ferranti, and Thomson-Houston | 198 kw. | Coke breeze coke, and rough slk. | £20,000 | £4,000 | 3/11 | Very f |
| Whitfield .... | 56 and 140 units.... | Direct .. | Non-condensing | Armoured ..... | — | 32 arcs.... | 7,700.... | 5d. | Direct .. | Ferranti, Reason, and Bastian | 450 kw. | Coke breeze | — | — | — | |
| olar..... | 2 150 kw., 2 25 kw. | Direct coupled | Non-condensing | Con. & triple con., arm. bit. cbls laid in wood troughs | — | — | — | — | — | — | — | — | — | — | — | |
| ker, Crompton, Forge & Silver- | 2 26 kw., 5 125 kw., 4 215 kw., 2 38 kw., motor | Direct .. | Non-con.; Wh'el'r surf. con. & cool. tower fixing | Bare strip, Silvertown and Callender's solid | 35,027 8 c.p. | 50 arcs .... | 11,000 .. | 5d. lighting, 2½d. power | Brighton | Ferranti and Thomson-Houston | 1,540 kw. | Small coal Durham | £41,000 | £31,000 | 5/1 | About wired |
| ..... | 84 kw. ..... | Direct .. | Non-condensing | Callender's triple conc. fdrs. 3 core dis., steel arm'd. | — | 24 arcs, 100 incandsnt. | 3,800.... | 7d. first hour, 4d. after | Wright's max. demand | Ferranti ..... | 168 kw. | Steam coal | — | — | — | |
| ..... | 35 kw. ..... | Direct .. | Condensers (Ledward) | I.R. cables in earth. pipes and lead cov. B.I.W. Co. sol. sys. | Equivalent 9,024 8 c.p. | 452 incndsnt. 10 arcs | 2,550.... | 5d. unit, £6 an. kw. max. dem. 2d. per unit | — | Hookham, Ferranti, and Aron | 210 kw. | Washed nuts | £20,275 | £9,261 | 8/1 | About |
| ..... | 2 115 amps., 1 410 amps. | Direct coupled | Non-condensing | Tri. con. feeders, 3 core dis. | 10,000 .... | — | 6,228.... | 7d., 5d. and 2d. | Wright's | Ferranti ..... | 293·5 | Welsh sm'keless steam coal | £20,335 | £6,280 | 3/6 | 2,705 la units |
| ..... | — | Direct .. | Non-condensing | Triple concen. armoured | 27 arcs, 7,527 8 c.p. | 290 16 c.p., 34 arcs | 7,000 .. | 6½d., motors 4d. per unit | 50 % reb. af. ern. 12s. 8 c.p. an. | Ferranti, Hookhm., Thomson-Hston., Aron, and Bastian | 625 kw., without cells | Anthracite peas, Powell Duffryn | £23,000 | £19,000 | — | 1,580 8 |
| Forge (engines ) | 2 20 kw., 2 100 kw. | Direct .. | Non-condensing | Net work, 3 wire.. | 5 arcs .... | 14 arcs, 181 lamps 2 10 c.p. each (*a*) | 4,254, from May, '99 | 6d. and 2d. .. | Demand indicator | Thomson-Hstn., Bastian, Long-Schttnr. (prepay.) | 240 kw. | Welsh coal | Not finished | | Not yet run full year | |
| ..... | 80 kw., 150 and 200 kw. | Direct .. | Non-condensing | Callender's in stoneware casings | 129,000 8 c.p. | — | 16,000 .. | 6d. to 3d. lighting, 3d. power | Brighton | Hookham and Ferranti | 3,060 kw. | Welsh coal | — | — | 5/8 | All new tions |
| Crompton .... | 50 and 150 kw. .... | Direct .. | Condens. (Ledward evap., Edwards air p'mps) | Ld. cov. pap., rub. cables in iron pipes & bare strip in cul. | 183,462, inclu. Knightsbridge Wks. Equivalt. of 17,432 8 c.p. | 1 arc..... | 29,724 .. | 6d. at 100, 5d. at 200, 4d. power | Rebates | Aron, Ferranti and Hookham | 1,000 kw. | Welsh coal | £263,481 both works and whole system | | 6/– | 120,727 |
| ..... | 125 kw. each ..... | Direct .. | Non-condensing | Bare copper and Callender's bitumen | — | — | 6,896.... | 6d. to 3¾d. (*b*) | Sliding scale | Hookham ..... | 600 kw. | Welsh steam coal | — | — | 12/11 | 1,027 8 |
| Siemens .... | 120 and 200 kw..... | Direct .. | Non-condensing | Cables and bare strip, in Doulton conduits | 35,500 8 c.p. | — | 1,808 8 c.p. | 8d. at 100, 6d. at 200, 4d. day load | By meter | Aron, Ferranti, and Hookham | 620 kw. | Welsh coal | £31,107 | £52,637 | 6/5 | About co |
| ..... | — | Direct .. | Non-condensing | Callender's bitu., Siemens, bare copr., and B.I.W. | 163,650 8 c.p. | 61 arcs .... | 21,897 .. | Ltg. 6d. to 4d., less 8 %, pwr. 3d. | 1st 4,000 6d., aft. 4d., less 8 % | Hookham, Ferranti, Aron, and T. H. | 3,880 kw. | Coal ..... | — | — | 9/2 | |
| Platt, and Siemens | 5 100 kw., 1 75 kw., 2 40 kw., 12 250 kw. | Direct .. | Non-condensing | Callender's in casing, armoured and paper cables | 182,689 8 c.p. | — | 48,453 .. | 6d. lighting, 4d. power | Sliding scale | Aron, Ferranti, and Hookham | 3,555 kw. | Welsh coal | — | — | — | Insigni |
| , Siemens, and | 50 to 500 kw. ..... | Direct .. | Condensing.... | Bare strip and armoured cable | 110,462 8 c.p. | 230 arcs. .. | 20,276 8 c.p. | Indictr. systm., 6d. 1st 1½ hs., 3d. after | Brighton, optional | Aron, Hookham, Ferranti, and Thomson | 2,590 kw. | Coal ..... | Approx £112,419 inclu. lanc | imately £129,574 | 7/6 | |
| pton, Siemens, | Up to 225 kw. .... | Direct .. | — | Armoured, strip and casing | — | 12 arcs .... | 427,000.. | 6d. lighting, 3d. pwr., with rebates | Rebates and discounts | Aron, Ferranti .. | 6,100 kw. | Welsh coal | — | — | (*c*) .... | All new co |
| att 4 pole .... | 2 60 kw. in tandem on small engine, 1 275 kw. on large eng. | Direct .. | Non-condensing | B.I.W. solid, 3 single mains | — | 50 arcs .... | — | 8d. 1st hr., 1d after | Wright's | Reason..... | 395 kw. | Welsh .... | — | — | — | |
| , Allen 2 pole, ulti-polar | 3 110 kw. each, 1 100 kw. | Direct and belts | Surface cndnsg. (Thames water us'd for cooling) | Cllndr.'s ld, cov. ar., 3 core dis. tpl. fdrs., vul. bit dis. c.i. ps. | 10,023 .... | — | 5,203.... | 6d. light, 3d. power | 5 % in 14 days | Ferranti and Aron | 430 kw. | Welsh coal | — | — | 6/11 | |

# H PRESSURE CONTINUOU

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| l ..... | 75 kw. ..... | Direct .. | Non-condensing | B.I.W. conc. .... | Dec. 31, '99, 9,237 | 22 10 amp. arcs, 44 16 c.p. incan. | 9,237 .... | 6d. 2 hs., 3d. aft. ltg., 6d. 1 hr., 1½d. aft. pwr. | Brighton | Ferranti and Cham.-Hookham | 225 kw. | Coal ..... | £29,000 (approx.) | — | — | 9,237.. |
| ston series.... | 18 arc lighter ..... | Belt .... | — | British Insulated Wire Co.'s, lead covered | — | 17 arc, 3 32 c.p. incandescent | — | — | — | — | 18 arcs | Gas ..... | — | — | — | |
| nes, 2 Parker, 2,250 v. | 2 44 kw., 2 115 kw., 2 180 kw., 2 45 kw. 2 202 kw., 2 520 kw. | Direct .. | Condensing.... | Bare strip & armd. con., 3 core jute ins. l-ad cov. and armd. | 105,000 8 c.p. | — | 35,000 .. | 5d. or 5½d. first hr., 2½d. after, 2½d. power | Brighton | Hookham, Ferranti, and Thomson | 2,210 kw. | Steam coal | £72,000 | £55,000 | — | Majorit |
| Phillips, and | 2 9·5 units, 1 24 units | Belt .... | Non-condensing | Overhead ..... | 2,160 8 c.p. | 12 50 c.p., 76 20 c.p. | 210, and 1 20 c.p. for streets | 6d. and 5d. lighting, 3d. power | — | Hookham ..... | 68 kw. | Coal ..... | £3,500 | £950 | 5/2 | 216, 230 |
| ..... | 6 30 kw. ..... | Belt .... | Condensing.... | Steel armoured .. | — | 187 arcs .. | — | — | — | — | 180 kw. | Welsh coal | £20,000 | | — | |
| ar, Parsons | 3 90 kw., 1 200 kw. | Direct coupled | Changing over to condensing | H.T fds. con., solid, twin cbs., L.T. fds. & dis., Call.'s conc. | 30 arcs .... | 104 arcs, 96 incand. | 5,000; 5,000 waiting connect. | 5d. per unit, or reb. 7d. 1st hr. 3d. after 7d. | Dir. on cur. con. & max. demand | Chamberlain-Hookham | 490 kw. | Coal ..... | £35,211 | £8,000 | — | 10,000 |
| ..... | 3 90 kw., 1 100 kw., 1 260 kw. | Ropes and belt | Condensing.... | H.T. i.r. cables in iron pipes L.T. Callender's | 30 arcs and 25,500 8 c.p. | 32 arcs and 48 16 c.p. | 3,800.... | — | — | Hookham and Ferranti | 630 kw. | Welsh coal | £67,000 | £30,000 | 8/- | |
| by power supplier Vale Col'ry | 14 kw. ..... | Belt .... | — | Overhead..... | — | 23 arcs.... | — | — | — | — | — | — | — | — | — | |
| ..... | 3 80 kw., 1 170 kw... | Direct .. | Condensing.... | H.T. con. rub., Call. v b. solid, Call. lead shethd. in i.p., L.T. Call., arm., in grnd. | 12,613 8 c.p. | 19 arcs .... | 1,732.... | 6d. first 1½ hours, 2d. afterwards | Brighton | Hookham ..... | 410 kw. | Slack .... | £20,300 | £9,100 | 6/- | None |
| rker ..... | 4 140 kw., 1 70 kw., 2 220 kw. | Rope and direct coupled | Ledward ejector condenser | Callender's solid.. | 22,688 8 c.p. & 767 power and heat | 51 arcs .... | 4,745, and 387 pwr. and heat | 6d. 2 hrs. in winter, 1 hr. in summer, 3d. all above | Brighton | Ferranti and Chamberlain-Hookham | 1,040 kw. | — | £70,000 | £20,000 | 8/6 | 4,000.. |
| ..... | 3 165 kw., 3 70 kw., 3 250 kw. | Direct .. | Non-condensing | Paper in Doulton conduits, rubber cables | — | 160 arcs .. | — | 5d. & 2d. ltg., 2d. pwr., all round 4½d. | Brighton | Ferranti and Hookham | 1,355 kw. | Refuse and coal | — | — | — | None.. |
| ..... | 4 90 kw., 1 45 kw., 1 200 kw. | Ropes and direct | Non-condensing | Lead covered in ground and some rubber in pipes | 26,000 8 c.p. | None..... | 9,000.... | 6d., 5d. and 4½d. during 1900 | Rebate .. | Ferranti, Hookham and Aron | 605 kw. | Welsh coal | — | — | 6/1 | None.. |


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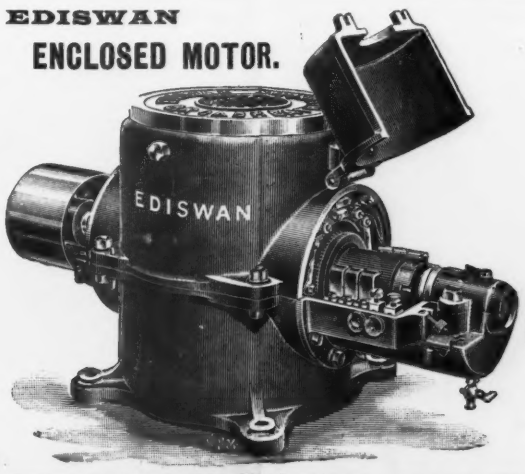


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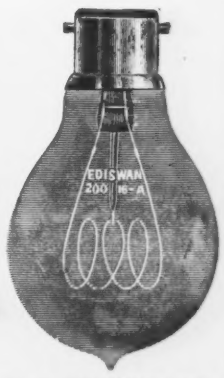


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| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| kham .... | kw. 850 amp. | Small coal | (31 Mar. 1899) £25,565 | | 8/9 and 12/6 | None ..... | 200 v. 100 v. to 115 v. | 70 h.p. ..... | — | — | Ogmore Valley (60) | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| p., 7 do. 134 h.p., 3 do. 700 h.p. | Siemens | — | Direct | — | | 8 c.p. | | | 1d. power | | Hookham | kw. | |
| ype | J. C. Howell | 1 200 amps., 1 300 amps., 5 70 amps. | Belt | Non-condensing | Overhead wires | 1,000 16 c.p. | 180 incand. | 100 | 6d. and 8d. | Contract chiefly | Ferranti | 850 amp. | Sm |
| h.p., 2 do. 100 h.p., 4 do. 360 h.p. | Charlesworth Hall, and Siemens | 2 36 kw., 2 60 kw., 2 120 kw., 4 225 kw. | Direct | Condensing | Bare strip & rub. & pap. cabs. in iron pipes & bit. cabs. | 32,281 8 c.p. | 28 arcs | 5,900 | 4d. & 2d. priv. customers 2½d. street lgt. | Brighton 2 hours | Ferranti | 1,332 kw. | Sla |
| (Belliss) | 2 Parker, 1 Siemens direct coupled to engine | 2 30 kw., 1 33 kw. | Ropes and direct driven | Non-condensing | Callender's armoured cables | 4,000 8 c.p. | — | 180 | 7d. | Meter | Hookham and Ferranti | 93 kw. | Co |
| i.h.p , 2 (Willans) Villans) 25 i.h.p. | Crompton and Parker | 2 34 kw., 1 13 kw., 1 70 k.w. | Direct | Non-condensing | Copper strip, and Callender's armoured | 23 arcs and 5,202 8 c.p. | — | 508 | 6d. lighting, 3d. power | By meter | Ferranti and Hookham | 151 kw. | Sm w |
| h.p., 1 (Belliss) 200 ss) 330 b.h.p. | Westminster, Siemens, and E.C.C. | 9 66 kw., 2 225 kw., 2 16·5 kw. motor alternators | Direct | Non-condensing | Bare strip cable in pipes and arm'rd H.T. concentric | 40,102 8 c.p. | 42 arcs, 10 amps. | 9,252 | 7d. and 4d., less 15 % for cash | Brighton | Ferranti and Hookham | 1,044 kw. | Sm |
| h.p., 2 200 h.p., | Latimer Clark, Muirhead & Co., Mordey | 3 67 kw., 2 45 kw., 2 130 kw., 230 v. | Direct | Non-condensing | Bare strip, and Henley, Silvert'wn. and Glover cable | 14,310 8 c.p. | — | 1,930 | 7d., after Apl. 6d. lighting, 4d. power | — | Ferranti | 540 kw. | We |
| h.p., 1 (Shanks) lliss and Morcom .p. | 1 (Flather) multi-polar, 1 (Silvertown) shunt wound, Crompton | 1 200 amps., 1 230 amps. | Belt and direct | Non-condensing | B.I.W. paper insulation lead cov. in pipes | 600 8 c.p. | 14 25 c.p. | 100 | 6d. | — | Ferranti | — | We |
| (Gilkes) turbine, Parker set 84 kw., , 420 revs.; 1 new et 92 kw. erecting | Parker. 2 boosters 70 v., 70 amps., 2 machines 230 v., 100 amps., all on one shaft; 1 84 kw., 1 92 kw. erecting | Turbine runs at 28 revs., and is coupled by gearing & belting to balance set | — | Wright's heater condenser | Callender's 3 core distrbtrs., T.C.C. feeders | 148 consumers, 6,228 8 c.p. equiv. | None | 91 consumers, 4,059 | 7d., 4d. and 2d. | Rebate | Ferranti, Hookham, and Schattner | 166 kw. | Far sma 10/8 deli |
| | 1 Crompton, 2 Kapp, 1 Veale | 1 44 kw., 2 21 kw., 1 9 kw. | Belts and counter shafting | Non-condensing | Parallel | 8 arcs, 2,000 incan. | — | — | — | Rebate 6½d., 3½d. | Chamberlain and Hookham | 95 kw. | Coa |
| p., 2 (Belliss) 150 | Parker | 3 33 kw., 2 100 kw. | Direct | Non-condensing | Callender's armoured cables | 8,394 | 4 arcs, 24 fixing | 2,894 | 7d., 4d. and 2d. | Brighton | Thomson, Ferranti, and Chamb'lain-Hookham | 299 kw. | Coa |
| h.p., 2 (Willans) elliss) 140 h.p., 2 h.p., 1 (Willans) | Crompton | 3 120 kw., 2 100 kw., 1 90 kw., 2 60 kw., 1 30 kw., 1 60 kw. motor | Direct | Non-condensing | Bare strip, diatrine con. for altern. mains | 18,000 8 c.p. | 62 arcs | 7,337 | 6d. lighting, 3d. power | Brighton | Ferranti, Hookham, Aron, and Shallenberger | 780 kw. | Sma |
| | E.C.C. | 3 66 kw. each | Rope | Jet condenser | Vulcanised rubber in Doulton conduits | 7,500 8 c.p. | 4 arcs | 500 | 7d. & 3d. ltg. 3d. power | Brighton | Hook'm, Ferranti, and Thomson-Houston | 198 kw. | Cok co ro |
| h.p., 2 (Willans) | McClure and Whitfield | 56 and 140 units | Direct | Non-condensing | Armoured | — | 32 arcs | 7,700 | 5d. | Direct | Ferranti, Reason, and Bastian | 450 kw. | Cok |
| | Brush multi-polar | 2 150 kw., 2 25 kw. | Direct coupled | Non-condensing | Con. & triple con., arm. bit. cbls laid in wood troughs | — | — | — | — | — | — | — | |
| p., 5 (Belliss) 200 s) 50 h.p. | Holmes, Parker, Crompton, Sunderland Forge & Silvertown | 2 26 kw., 5 125 kw., 4 215 kw., 2 38 kw., motor | Direct | Non-con.; Wh'el'r surf. con. & cool. tower fixing | Bare strip, Silvertown and Callender's solid | 35,027 8 c.p. | 50 arcs | 11,000 | 5d. lighting, 2½d. power | Brighton | Ferranti and Thomson-Houston | 1,540 kw. | Sma Du |
| pound 110 b.h.p. | Parker 2 pole | 84 kw. | Direct | Non-condensing | Callender's triple conc. fdrs. 3 core dis., steel arm'd. | — | 24 arcs, 100 incandsnt. | 3,800 | 7d. first hour, 4d. after | Wright's max. demand | Ferranti | 168 kw. | Stea |
| p. | Crompton | 35 kw. | Direct | Condensers (Ledward) | I.R. cables in earth. pipes and lead cov. B.I.W. Co. sol. sys. | Equivalent 9,024 8 c.p. | 452 incndsnt. 10 arcs | 2,550 | 5d. unit, £6 an. kw. max. dem. 2d. per unit | — | Hookham, Ferranti, and Aron | 210 kw. | Was |
| p., 1 (Belliss) 300 | Parker | 2 115 amps., 1 410 amps. | Direct coupled | Non-condensing | Tri. con. feeders, 3 core dis. | 10,000 | — | 6,228 | 7d., 5d. and 2d. | Wright's | Ferranti | 293·5 | Wels les co |
| i.h.p., 1 do. 100 0 i.h.p., 1 (Belliss) | Siemens | — | Direct | Non-condensing | Triple concen. armoured | 27 arcs, 7,527 8 c.p. | 290 16 c.p., 34 arcs | 7,000 | 6½d., motors 4d. per unit | 50 % reb. af. ern. 12s. 8 c.p. an. | Ferranti, Hookhm., Thomson-Hston., Aron, and Bastian | 625 kw., without cells | Ant peas Duf |
| h.p. | Sunderland Forge (engines and dynamos) | 2 20 kw., 2 100 kw. | Direct | Non-condensing | Net work, 3 wire | 5 arcs | 14 arcs, 181 lamps 2 10 c.p. each (*a*) | 4,254, from May, '99 | 6d. and 2d. | Demand indicator | Thomson-Hstn., Bastian, Long-Schttnr. (prepay.) | 240 kw. | Wel |
| | E.C.C. | 80 kw., 150 and 200 kw. | Direct | Non-condensing | Callender's in stoneware casings | 129,000 8 c.p. | — | 16,000 | 6d. to 3d. lighting, 3d. power | Brighton | Hookham and Ferranti | 3,060 kw. | Wel |
| 0 h.p., 7 (Willans) illans) 80 h.p. | Siemens and Crompton | 50 and 150 kw. | Direct | Condens. (Ledward evap., Edwards air p'mps) | Ld. cov. pap., rub. cables in iron pipes & bare strip in cul. | 183,462, inclu. Knightsbridge Wks. | 1 arc | 29,724 | 6d. at 100, 5d. at 200, 4d. power | Rebates | Aron, Ferranti and Hookham | 1,000 kw. | Wel |
| nes 250 h.p. each | 4 pole | 125 kw. each | Direct | Non-condensing | Bare copper and Callender's bitumen | Equivalt. of 17,432 8 c.p. | — | 6,896 | 6d. to 3¾d. (*b*) | Sliding scale | Hookham | 600 kw. | Wel co |
| | Crompton and Siemens | 120 and 200 kw. | Direct | Non-condensing | Cables and bare strip, in Doulton conduits | 35,500 8 c.p. | — | 1,308 8 c.p. | 8d. at 100, 6d. at 200, 4d. day load | By meter | Aron, Ferranti, and Hookham | 620 kw. | Wel |
| p. | Siemens | — | Direct | Non-condensing | Callender's bitu., Siemens, bare copr., and B.I.W. | 163,650 8 c.p. | 61 arcs | 21,897 | Ltg. 6d. to 4d., less 8 %, pwr. 3d. | 1st 4,000 6d., aft. 4d., less 8 % | Hookham, Ferranti, Aron, and T. H. | 3,880 kw. | Coa |
| h.p., 1 (Willans) illans) 80 h.p., 12 p. | Mather and Platt, and Siemens | 5 100 kw., 1 75 kw., 2 40 kw., 12 250 kw. | Direct | Non-condensing | Callender's in casing, armoured and paper cables | 182,689 8 c.p. | — | 48,453 | 6d. lighting, 4d. power | Sliding scale | Aron, Ferranti, and Hookham | 3,555 kw. | Wel |
| 80 i.h.p., 3 (Belliss) Peache) 250 i.h.p. | Kapp, Latimer, Siemens, and Crompton | 50 to 500 kw. | Direct | Condensing | Bare strip and armoured cable | 110,462 8 c.p. | 230 arcs | 20,276 8 c.p. | Indictr. systm., 6d. 1st 1½ hs., 3d. after | Brighton, optional | Aron, Hookham, Ferranti, and Thomson | 2,590 kw. | Coal |
| 361 i.h.p. | E.C.C., Crompton, Siemens, and Goolden | Up to 225 kw. | Direct | — | Armoured, strip and casing | — | 12 arcs | 427,000 | 6d. lighting, 3d. pwr., with rebates | Rebates and discounts | Aron, Ferranti | 6,100 kw. | Wel |
| 200 i.h.p., 1 do. | Mather and Platt 4 pole | 2 60 kw. in tandem on small engine, 1 275 kw. on large eng. | Direct | Non-condensing | B.I.W. solid, 3 single mains | — | 50 arcs | — | 8d. 1st hr., 1d after | Wright's | Reason | 395 kw. | Wel |
| s. 110 kw., 1 (Allen) kw., 1 (Bumstead-losed 110 kw. | Parsons 2 pole, Allen 2 pole, E. A. & G. multi-polar | 3 110 kw. each, 1 100 kw. | Direct and belts | Surface cndnsg. (Thames water us'd for cooling) | Cllndr.'s ld, cov. ar., 3 core dis. tpl. fdrs., vul. bit dis. c.i. ps. | 10,023 | — | 5,203 | 6d. light, 3d. power | 5 % in 14 days | Ferranti and Aron | 430 kw. | Wel |

# HIGH PRESSURE CONT

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 kw. | 4 pole Universal | 75 kw. | Direct | Non-condensing | B.I.W. conc. | Dec. 31, '99, 9,237 | 22 10 amp. arcs, 44 16 c.p. incan. | 9,237 | 6d. 2 hs., 3d. aft. ltg., 6d. 1 hr., 1½d. aft. pwr. | Brighton | Ferranti and Cham.-Hookham | 225 kw. | Coal |
| 20 h.p., nom. 42 b. | Thomson-Houston series | 18 arc lighter | Belt | — | British Insulated Wire Co.'s, lead covered | — | 17 arc, 3 32 c.p. incandescent | — | — | — | — | 18 arcs | Gas |
| h.p., 2 do. 200 h.p., 2 do. 100 h.p., 2 do. llen) 800 h.p. | Siemens, Holmes, 2 Parker, 220 v., 4 do., 2,250 v. | 2 44 kw., 2 115 kw., 2 180 kw., 2 45 kw. 2 202 kw., 2 520 kw. | Direct | Condensing | Bare strip & armd. con., 3 core jute ins l. ad cov. and armd. | 105,000 8 c.p. | — | 35,000 | 5d. or 5½d. first hr., 2½d. after, 2½d. power | Brighton | Hookham, Ferranti, and Thomson | 2,210 kw. | Stea |
| (Davey-Paxman) h.p. | Johnson and Phillips, and Taunton | 2 9·5 units, 1 24 units | Belt | Non-condensing | Overhead | 2,160 8 c.p. | 12 50 c.p., 76 20 c.p. | 210, and 1 20 c.p. for streets | 6d. and 5d. lighting, 3d. power | — | Hookham | 68 kw. | Coal |
| nd., 150 h.p. | Siemens | 6 30 kw. | Belt | Condensing | Steel armoured | — | 187 arcs | — | — | — | — | 180 kw. | Wels |
| ker) 125 i.h.p., 2 15 turbine 300 h.p. | Parker bi-polar, Parsons bi-polar | 3 90 kw., 1 200 kw. | Direct coupled | Changing over to condensing | H.T fds. con., solid, twin cbs., L.T. fds. & dis., Call.'s conc. | 30 arcs | 104 arcs, 96 incand. | 5,000; 5,000 waiting connect. | 5d. per unit, or reb. 7d. 1st hr. 3d. after 7d. | Dir. on cur. con. & max. demand | Chamberlain-Hookham | 490 kw. | Coal |
| p., 1 do. 200 h.p., | E.C.C., 1,000 v. | 3 90 kw., 1 100 kw., 1 260 kw. | Ropes and belt | Condensing | H.T. i.r. cables in iron pipes L.T. Callender's | 30 arcs and 25,500 8 c.p. | 32 arcs and 48 16 c.p. | 3,800 | 7d. | — | Hookham and Ferranti | 630 kw. | Wels |
| — | Brush, driven by power supplied from Rother Vale Col'ry | 14 kw. | Belt | — | Overhead | — | 23 arcs | — | — | — | — | — | |
| i.h.p., 1 vertical | Parker | 3 80 kw., 1 170 kw. | Direct | Condensing | H.T. con. rub., Call. v b. solid, Call. lead shethd. in i.p., L.T. Call., arm., in grnd. | 12,613 8 c.p. | 19 arcs | 1,732 | 6d. first 1½ hours, 2d. afterwards | Brighton | Hookham | 410 kw. | Slack |
| 20 h.p., 1 200 h.p., | E.C.C. and Parker | 4 140 kw., 1 70 kw., 2 220 kw. | Rope and direct coupled | Ledward ejector condenser | Callender's solid | 22,688 8 c.p. & 767 power and heat | 51 arcs | 4,745, and 387 pwr. and heat | 6d. 2 hrs. in winter, 1 hr. in summer, 3d. all above | Brighton | Ferranti and Chamberlain-Hookham | 1,040 kw. | |
| i.h.p., 3 do. 150 iss) 500 i.h.p. | E.C.C. | 3 165 kw., 3 70 kw., 3 250 kw. | Direct | Non-condensing | Paper in Doulton conduits, rubber cables | — | 160 arcs | — | 5d. & 2d. ltg., 2d. pwr., all round 4½d. | Brighton | Ferranti and Hookham | 1,355 kw. | Refus coal |
| ound 40 h.p. nom., 80 i.h.p., and 1 .h.p. | E.C.C. | 4 90 kw., 1 45 kw., 1 200 kw. | Ropes and direct | Non-condensing | Lead covered in ground and some rubber in pipes | 26,000 8 c.p. | None | 9,000 | 6d., 5d. and 4½d. during 1900 | Rebate | Ferranti, Hookham and Aron | 605 kw. | Wels |


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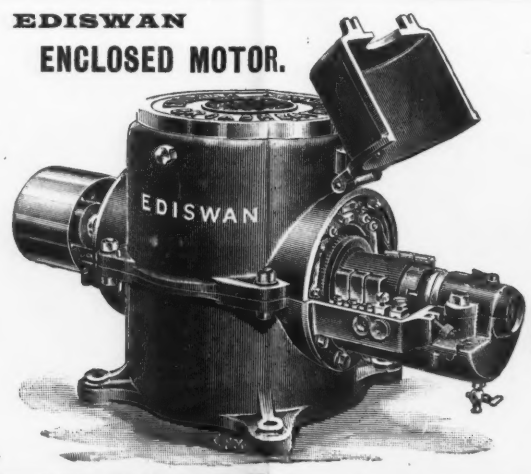


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| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ookham ..... | kw. 850 amp. | Small coal | (31 Mar. 1899) £5,565 | | 8/9 and 12/6 | None ..... | 200 v. 100 v. to 115 v. | 70 h.p. ..... | — | — | Ogmore Valley (60) |
| ..... | 1,332 kw. | Slack coal | Capital tu £67,600 | expendi-re | 5/3 | All..... | 210 v. and 105 v. | — | — | S. Wilmott Newington | Oldham .....(61) |
| and Ferranti | 93 kw. | Coal ..... | £5,867 | | 3/4 | All..... | 220 v. .... | 1 = 3 h.p. .... | — | E. Bremner Smith | Oswestry .....(62) |
| nd ookham | 151 kw. | Small coal washed | £8,741 | £1,051 | 5/0½ | None ..... | — | — | — | G. A. Maquay.. | Pontypool.....(63) |
| nd Hook- | 1,044 kw. | Small slack | — | — | – | — | — | — | Extensions of 1,000 kw. in hand | J. H. Tonge .. | Preston* .....(64) |
| ..... | 540 kw. | Welsh coal | £18,663 | £14,845 | 9/- | None ..... | 110 v. .... | — | — | M. C. Flemyng | Richmond (Surrey) (65) |
| ..... | — | Welsh coal | — | — | — | — | 100 v. .... | 1 = 1 h.p. .... | — | A. Jupp ..... | Rottingdean....(66) |
| Icokham, attner | 166 kw. | Farringdon small coal, 10/3 per ton delivered | £27,203 | £5,506 | 6/3 | All..... | 210 v. .... | 6 = 5¾ h.p..... | — | L. A. Hards .. | Salisbury .....(67) |
| ain and ookham | 95 kw. | Coal ..... | £6,000 | — | — | — | 100 v. .... | 14 = 14½ h.p.. | — | J. M. Coon .... | St. Austell.....(68) |
| Ferranti, mb'lain- n | 299 kw. | Coal ..... | — | — | 7/3 | All..... | 210 v. .... | 27 h.p. ..... | Approx. cost of extensions by Corporation £30,000 | C. M. Johnston | Shrewsbury ....(69) |
| Hook- ron, and erger | 780 kw. | Small coal | £55,000 | | 8/3 | None ..... | 100 v. and 200 v. | 35 = 160 h.p.. | — | F. H. Chaplin | Southampton*..(70) |
| Ferranti, homson- | 198 kw. | Coke breeze coke, and rough slk. | £20,000 | £4,000 | 3/11 | Very few ..... | 105 v. and 210 v. | — | — | J. Ferguson Bell | Stafford .....(71) |
| Reason, ian | 450 kw. | Coke breeze | — | — | — | — | 230 v. .... | 1 = 80 h.p., 1 = 4 h.p. | — | S. Meunier, A. J. H. Carter, (electrical man.) | Stockport .....(72) |
| | — | — | — | — | — | — | 230 v. .... | — | Station not ready for supply | J. J. Smith. Wm. Ford, genl. mnger. | Stockton .....(73) |
| nd Houston | 1,540 kw. | Small coal Durham | £41,000 | £31,000 | 5/1 | About half total wired | 110 v. and 220 v. | 420 h.p. ..... | — | John F. C. Snell | Sunderland ....(74) |
| ..... | 168 kw. | Steam coal | — | — | — | — | 210 v. .... | — | — | A. E. Mayes.... | Ventnor .....(75) |
| Ferranti, | 210 kw. | Washed nuts | £20,275 | £9,261 | 8/1 | About 50 ..... | 105 v. and 100 v. | 4 = 17 h.p..... | — | J. Gray Scott .. | Whitehaven....(76) |
| ..... | 293·5 | Welsh sm'ke-less steam coal | £20,335 | £6,280 | 3/6 | 2,705 lamps, 89·2 units | 210 v. .... | 2 = 6 h.p. .... | — | H. N. Warburton | Winchester ....(77) |
| Hookhm., -Hston., d Bastian | 625 kw., without cells | Anthracite peas, Powell Duffryn | £23,000 | £19,000 | — | 1,580 8 c.p. .... | 110 v. and 220 v. | 32·5 h.p. ..... | Wright's max. demand indicator now being introduced | A. E. Farrow .. | Windsor.....(78) |
| | | | | | | | | | | | **LONDON.** |
| Hstn., Long- prepay.) | 240 kw. | Welsh coal | Not finished | | Not yet run full year | — | 230 v. .... | 17 h.p. ..... | (*a*) 376 posts, 2 10 c.p. each when finished | S. E. Britton .. | Barking.....(79) |
| and Ferranti | 3,060 kw. | Welsh coal | — | — | 5/8 | All new connections | 200 v. .... | — | — | Percy Still .... | Chelsea .....(80) |
| anti and n | 1,000 kw. | Welsh coal | £263,481 both works and whole system | | 6/– | 120,727..... | 200 v. .... | 20 = 75 h.p. .. | — | H. W. Miller .. | Kensington Court Works (81) |
| ..... | 600 kw. | Welsh steam coal | — | — | 12/11 | 1,027 8 c.p. .... | 100 v. and 200 v. | — | (*b*) Price inclu. free wiring, mainten., clng. & renewals | Eustace Ridley | London .....(82) |
| ranti, ookham | 620 kw. | Welsh coal | £31,107 | £52,637 | 6/5 | About 80% of connections | 100 v. and 200 v. | 21 h.p. ..... | — | Geo. Schultz .. | Notting Hill ....(83) |
| n, Fer- on, and | 3,680 kw. | Coal ..... | — | — | 9/2 | — | 107 v. .... | — | — | Sydney T. Dobson | St. James's Parish (84) |
| rranti, kham | 3,555 kw. | Welsh coal | — | — | — | Insignificant .. | 100 v. and 200 v. | — | Work under the City of London Order, 1899, in hand | W. H. Patchell | St. Martin's in the Fields, Strand District. S. Holborn and St. Giles ..(85) |
| ookham, and | 2,590 kw. | Coal ..... | Approximately £112,419 £129,574 inclu. lanc | | 7/6 | — | 110 v. and 220 v. | 111 = 400½ h.p. | — | Sydney W. Baynes | St. Pancras ....(86) |
| anti .. | 6,100 kw. | Welsh coal | — | — | (*c*) .... | All new consumers | — | — | (*c*) Figures not yet made out | Dr. A. B. W. Kennedy | Westminster and St. George's (87) |
| ..... | 395 kw. | Welsh .... | — | — | — | — | 240 v. .... | — | Started running Dec., 16th, 1899 | A. Wright, consit W. C. P. Tapper, resident | Whitechapel ..(88) |
| nd Aron | 430 kw. | Welsh coal | — | — | 6/11 | — | 210 v. .... | 3 = 7 h.p. .... | Systm. chngd. Mar. '99, H.T. to L.T. d.c. supply uninterruptd | A. J. Fippard. Edmundsons, consultg. engrs | Woolwich‡ ....(89) |
| **CONTINUOUS.** | | | | | | | | | | | **PROVINCIAL.** |
| nd ookham | 225 kw. | Coal ..... | £29,000 (approx.) | — | — | 9,237..... | 220 v. .... | 10 = 46·5 e.h.p. | Extension in progress | H. R. Burnett.. | Barrow-in-Furness (1) |
| | 18 arcs | Gas ..... | — | — | — | — | — | — | — | A. Sharp ..... | Bridlington.....(2) |
| and | 2,210 kw. | Steam coal | £72,000 | £55,000 | — | Majority ..... | 110 v. and 220 v. | 36 = 135 h.p. approximately | — | A. S. Barnard.. | Hull .....(3) |
| ..... | 68 kw. | Coal ..... | £3,500 | £950 | 5/2 | 216, 230 v. .... | 115 v. and 230 v. | 2 = 6½ h.p..... | — | G. J. T. Parfitt.. | Keynsham .....(4) |
| | 180 kw. | Welsh coal | £20,000 | | — | — | — | — | — | R. V. Macrory.. | Londonderry ....(5) |
| in- ookham | 490 kw. | Coal ..... | £35,211 | £8,000 | — | 10,000 ..... | 220 v. .... | 8 = 26 h.p. .... | — | C. F. Parkinson | Morecambe.....(6) |
| and Ferranti | 630 kw. | Welsh coal | £67,000 | £30,000 | 8/- | — | 100 v. .... | 25 h.p. ..... | — | Percy J. Rea .. | Oxford .....(7) |
| | — | — | — | — | — | — | — | — | — | Wm. H. Barwell | Treeton.....(8) |
| ..... | 410 kw. | Slack .... | £20,300 | £9,100 | 6/– | None ..... | 105 v. .... | 19 = 52 h.p. .. | — | A. Wyllie .... | Walsall.....(9) |
| ad lain- ookham | 1,040 kw. | — | £70,000 | £20,000 | 8/6 | 4,000..... | 110 v. and 220 v. | 16 = 26 e.h.p... | — | C. E. C. Shawfield | Wolverhampton(10) |
| | | | | | | | | | | | **LONDON.** |
| ad ookham | 1,355 kw. | Refuse and coal | — | — | — | None..... | 150 v. .... | About 400 b.h.p. | — | C. Newton Russell | Shoreditch .....(11) |
| ookham | 605 kw. | Welsh coal | — | — | 6/1 | None..... | 100 v. .... | 3 = 100 h.p. .. | — | A. L. Phillips.. | Sydenham .....(12) |


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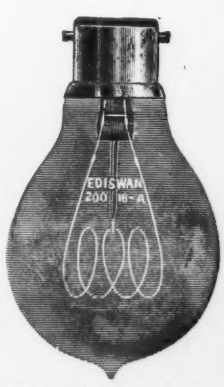


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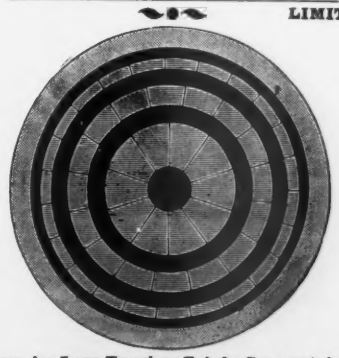

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